As It Seems To Us

CHILDREN AND BLASTING CAPS

EXPLOSIVES have many peacetime services to perform, and this is notably the case in the excavating of rock for all sorts of public improvements and the extension of engineering undertakings of one sort or another. Much of this work is done in the open and under conditions that make it difficult to keep the curious or the trespassing public safely away from the scenes of operation. This is particularly true during those periods when the workers withdraw to eat and to rest or during the longer hours of inaction. If the men, in their haste to quit, leave blasting caps on the ground or elsewhere where they can be picked up by anyone, they unintentionally expose to injury if not death persons that may chance upon these caps and misuse them.

This hazard is fully realized by the Institute of Makers of Explosives; and each year that organization carries on a nationwide campaign in the hope of reducing accidents due directly to the ignorant handling of misappropriated blasting caps. Children are the principal sufferers; and several hundred of them are maimed or killed annually through playing with blasting caps that they have picked up in their leisure hours when encroaching upon the scene of work calling for the use of explosives and blasting caps.

The majority of these accidents occur in rural sections; and the hazardous caps are discovered by the youngsters where they have been left by careless persons believing, possibly, that children were nowhere around nor likely to turn up during an unguarded period. The children explode the unfamiliar caps by striking them with hammers, by picking them with pins, by throwing them into fires, or by subjecting them to the heat of friction in one way or another. Taken in the order in which they predominate, injuries are caused to the eyes, the hands, and the body; and in any case the consequences are serious if not disastrous.

The aim of the Institute is to broadcast the peril to which the children of the Nation are thus exposed; to stress the need of care at all times on the part of those engaged in the use of blasting caps; and to urge the exercise of every precaution that will prevent these caps from getting into the hands of heedless or uninformed youngsters.

BERMUDA TO HAVE A RAILROAD

IT IS easily within the memory of many of us how the Island of Nantucket, off the coast of Massachusetts, set its face for a while firmly against modernity by prohibiting the invasion of the motor car. The authorities of that lovely island haven came in season to see the unwisdom of their opposition to the automobile. In a similar fashion Bermuda, another favorite tourist resort, has let down her bars after long resistance against anything that might compete with the horse, the carriage, and the bicycle. Bermuda, after two years of intermittent building, is soon to have a railroad ready for service. We are not certain that this submission to modernity is to be commended. Bermuda is one of those naturally charming spots that we should much prefer to see unchanged.

PROGRESS EXACTS ITS PRICE

NECESSARILY belated, but none the less earnest, we wish now to express our heartfelt sympathy to all affected or bereaved by the appalling loss of the dirigible *R-101*. As we go to press, the conclusive reasons for the disaster are unknown, and just what an exhaustive investigation will reveal is a matter of speculation. The outstanding fact is that another peacetime rigid dirigible has come to a sudden end, and right on the heels of wireless reports announcing that all was going well with the great craft.

We are well aware that much adverse criticism has been directed toward the advocates and the builders of this type of airship; and some of these doubters will be vociferous now in condemning the officials immediately responsible for the construction of the *R-101* and for their daring to dispatch her upon the ambitious flight that was abruptly halted after the ship was but a few hours away from her home port. Judged from the purely human aspect of the venture, these critics should be silenced by the sacrifice of the lives of the men who had faith in the craft; and let us remind those that will surely carp about the material loss that from the very character of the experiment a large sum necessarily had to be spent to provide a demonstration on a sufficiently conclusive scale.

To be of practical commercial value, dirigible airships must be of gigantic proportions; and, because of the nature of the sustaining medium in which they are designed to move, their structures have to be so fashioned that strength and lightness shall be assured. This has made exceptional demands both upon the metallurgist and upon the aeronautical engineer. That much must yet be done to provide improvements is manifest—each disaster emphasizing this and serving to point the way to these needful betterments. We are firm in our faith that the present catastrophe will prove fruitful in this respect and aid designers in this realm of architecture to go forward more confidently. What the Germans have done in producing the *Graf Zeppelin* is ample proof of what others may do in the building of large, long-distance rigid dirigibles.

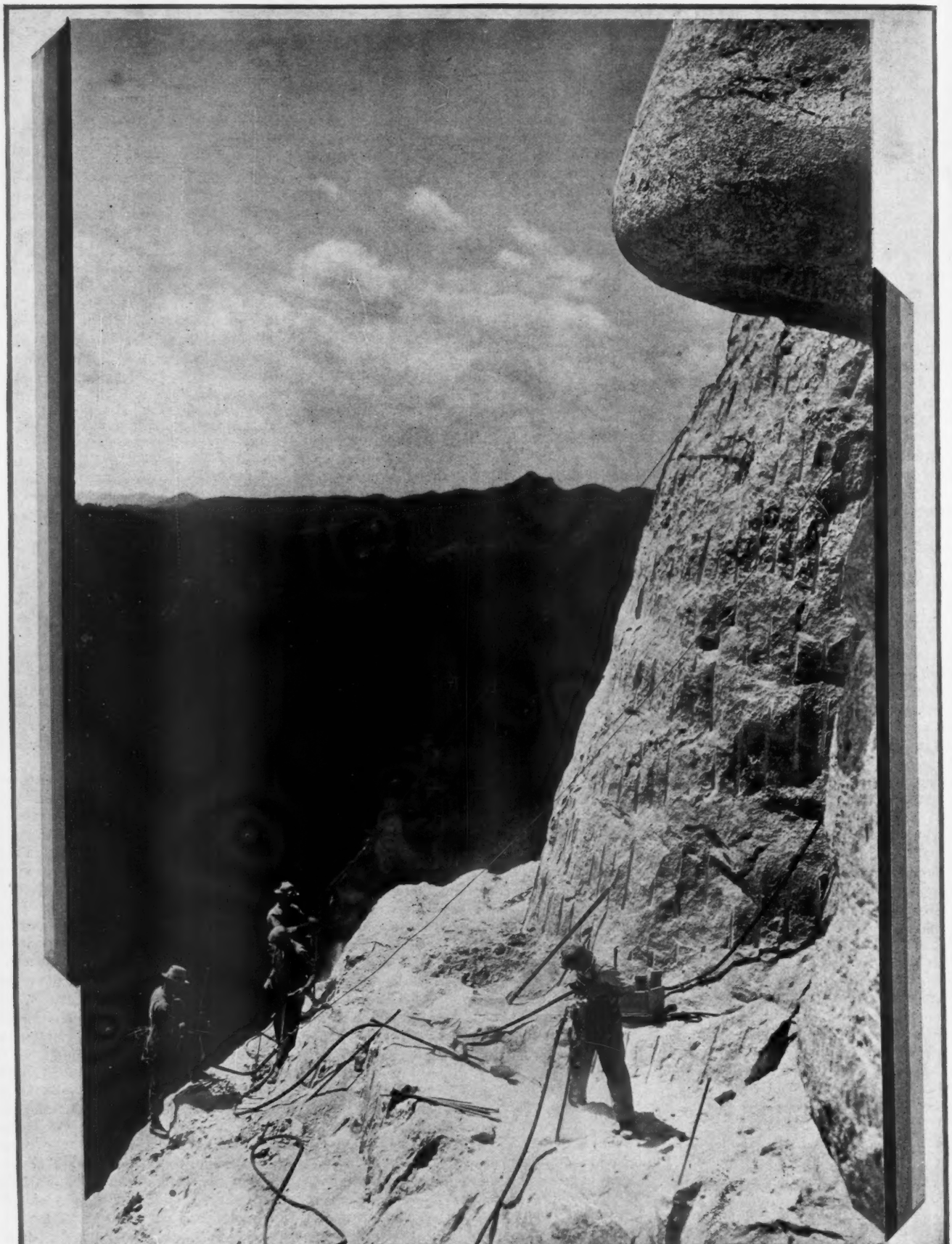
There are various ways in which the *R-101* might have been constructed or equipped to advantage. There are well-known safety agencies that might have been employed; but despite the lack of these the ship was apparently holding her own in the face of a violent storm until she suddenly headed downward and hit the earth. The force of that blow would probably have been sufficient to doom an ocean-going steamship constructed upon far sturdier lines. The loss of the *R-101* recalls our own loss of the dirigible *Shenandoah*, and distressing as that catastrophe was, faith in the type was not shattered among those best qualified to evaluate that order of aircraft.

SOUP FOR EVERYBODY

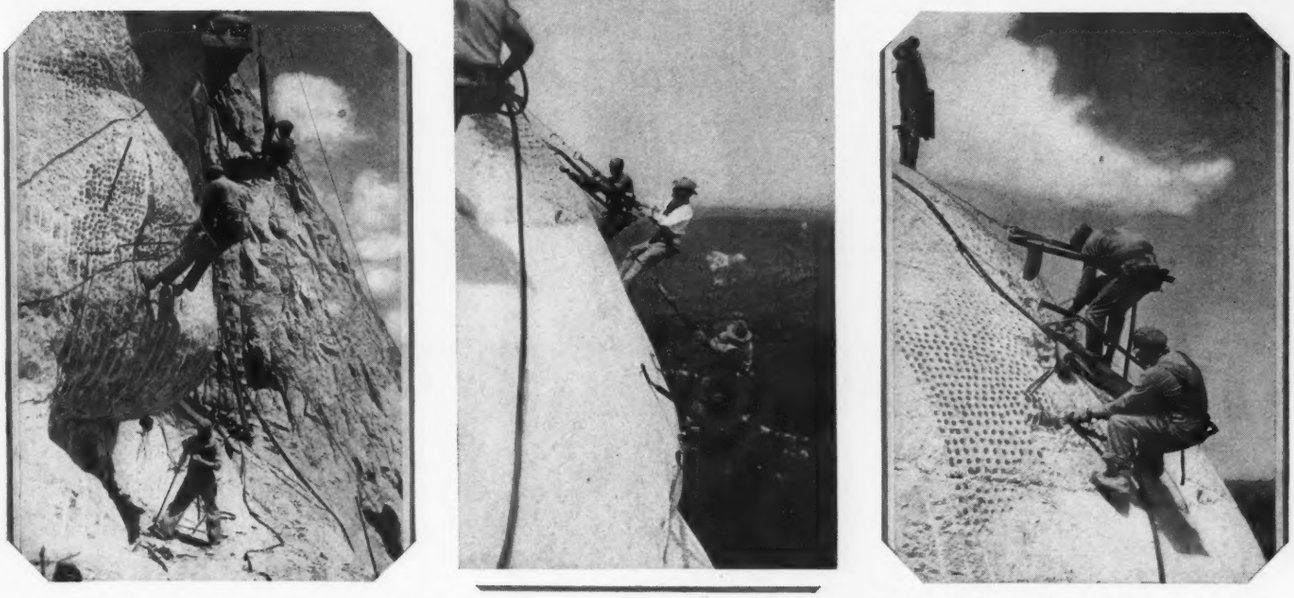
SOME gourmet has fittingly said that no dinner was worthy the name without soup. Like a good many other accepted truisms, the foregoing declaration fell generally on deaf ears until JOHN T. DORRANCE was stirred by it. That doctor of chemistry must have argued with himself: If soup be necessary to a rounded meal why not devise ways to satisfy the populace at large? Why not produce soup in cans so that by adding possibly only water and applying heat an appetizing course could be supplied instanter?

Doctor DORRANCE had many obstacles to overcome before he could produce an acceptable comestible; but his efforts must have been sufficiently persuasive to the palate of the financier to enable him to obtain backing wherewith to launch his enterprise—an enterprise that is now known the world over and certainly in every American home. Mindful of what the canned-soup industry means today to the housekeeper, to the camper, to the picnicker, and to numberless others, we have reason to be appreciative of Doctor DORRANCE'S initiative.

When someone complains that opportunities are now few and far between, let us remark that they were no more numerous when JOHN T. DORRANCE faced his career. Starting with a salary—if his wage could be so called—of $7.50 a week, he was able at his death, a short while ago, to will the amazingly large fortune of $150,000,000! It calls for no stretch of the imagination to grasp the fact that that splendid climax came only after a great deal of labor on the part of Doctor DORRANCE. Happily he inspired others to devise equipment that would meet his particular needs—such being the force of his industrial leadership. Let some of the rest of us find equally effective ways to appeal to the popular taste or demand.



Three rock drillers and a powderman, high up on Mount Rushmore in South Dakota, at work on the colossal memorial which Gutson Borglum is carving there.



Left—Drill runner putting in horizontal holes for the smoothing up of Washington's chin. To the right of him is the "steel monkey" descending in his harness with an armload of sharpened steels. Center—Gutzon Borglum, the sculptor, takes to a harness of his own devising to inspect the work on Washington's forehead. Mr. Borglum is the middle figure. Right—Workman with a plug drill, fitted with a moil-point steel, breaking out rock between shallow drill holes being put in by the man at his right with a "Jackhamer".

Mount Rushmore Memorial

By C. H. VIVIAN

ON the sheer 300-foot cliff of Mount Rushmore, in the heart of the Black Hills of South Dakota, Gutzon Borglum is carving for posterity a historical memorial depicting, on a colossal scale, the founding, expansion, preservation, and unification of the United States. The figures of four presidents —Washington, Jefferson, Lincoln, and Roosevelt—whose accomplishments played leading parts in these four phases of the nation's development, will be flanked by an entablature on which will be graven a 500-word history of the country to be written by Calvin Coolidge.

In magnitude, this sculpturing will exceed anything ever before attempted. The proportions will be several times those of the Egyptian Sphynx. The heads of the figures, which will be done in the round, will each measure 60 feet from the top of the head to the chin. The figures will be shown to the waist line, where they will fade into the cliff. The history will be cut into the rock in letters 3 feet high, and it is expected that they will be legible at a distance of three miles.

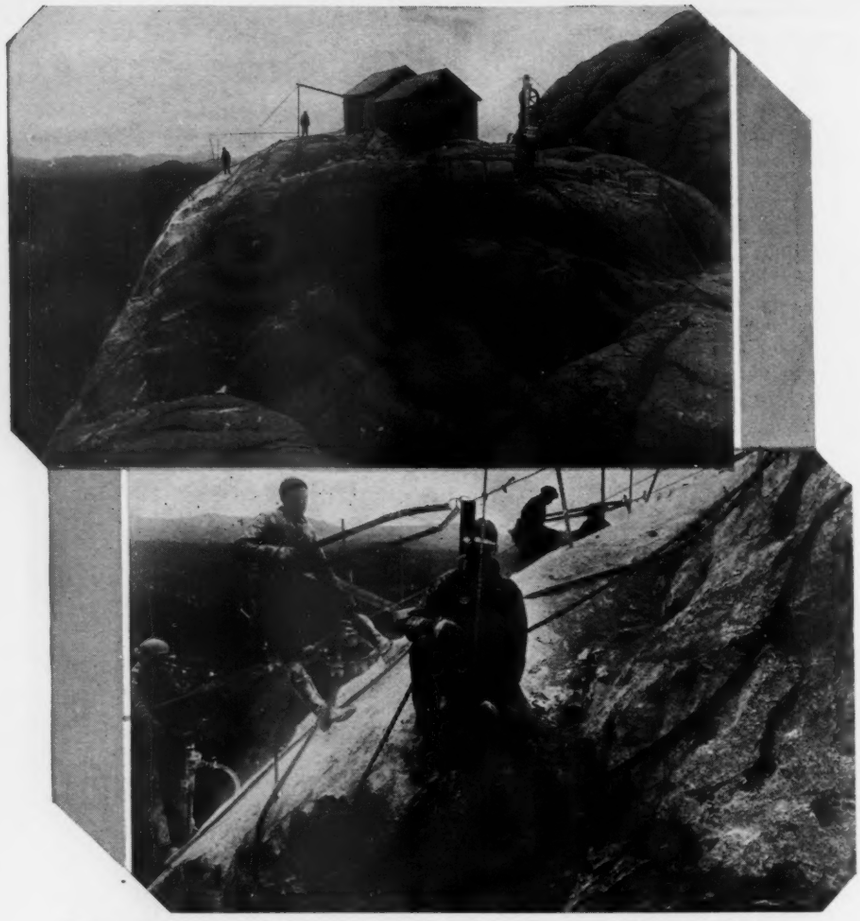
Actual work on the memorial has been underway at intervals since 1927, and it will require four to five more years to complete it. The total cost is placed at $500,000. To make the region readily accessible and to provide various vantage points from which the sculpturing may be viewed, the State of South Dakota will expend $250,000 for highways. More than one-fourth of this sum has already been spent.

At first glance it would appear that a more appropriate subject might have been chosen for the site—one more in keeping with the traditions of the region. In fact, some residents of South Dakota hold the opinion that a memorial to the American Indian or to the pioneers who won the West from the wilderness would better typify the history of the Black Hills. Closer consideration, however, will reveal that there is nothing incongruous in the plan. The work is a national memorial, designed to portray a story of more than local importance. Not only is the state selected close to the center of the country from east to west, but its history is inseparably linked with one of the outstanding episodes that will be included in the message that the stone will carry to future generations. For it was on the site of Fort Pierre, across the Missouri River from the City of Pierre, capital of South Dakota, that agents of the French king, Louis XV, in 1743, secretly buried a leaden plate on which it was set forth that France claimed for its own the vast territory known as Louisiana. It was the hope of the French ruler to thwart his country's ancient enemy, Great Britain, and to prevent the dominance of the Anglo-Saxon race in the western portion of America. The vision of Jefferson in purchasing this domain, in 1803, signally altered the history of the nation and was of inestimable aid in promoting the colonization of the West.

The idea of the memorial was born in the mind of Doane Robinson, state historian of South Dakota, in 1924. He wrote Mr. Borglum that there existed in the Black Hills an upthrust of granite that offered an opportunity for sculpture on a large scale, and invited him to inspect it at his convenience. Long an exponent of massive sculpturing, Mr. Borglum was at once responsive. He visited the section and viewed the pinnacles of granite known as "The Needles," which Mr. Robinson had in mind. He was not satisfied that they were suitable for the purpose. He went back to the Black Hills a second and a third time, and then announced that Mount Rushmore was his choice. Mr. Robinson and United States Senator Peter Norbeck, acting for the South Dakota State Park Board, did not favor Mount Rushmore. To finally settle the question of the location, Messrs. Borglum, Robinson, and Norbeck took to the saddle and revisited every prominent mass of rock in the area, sleeping under canvas for three weeks. In the end, Mount Rushmore was approved.

In announcing his choice, Mr. Borglum stated that he had selected Mount Rushmore because, of all the available sites, it best met the desired requirements: first, that the stone to be carved be situated so as to receive full sunlight during as much of the day as possible; second, that the granite be sound; third, that the stone be present in sufficiently large masses and with such freedom from fracture as to admit of group sculpture.

At its inception, the plan called for the financing of the undertaking by those individuals and business concerns that were directly concerned with the welfare and growth of the Black Hills. One of the major arguments



These views illustrate how measurements are made to direct the drillers. The boom in the upper picture is mounted over a large protractor. From this boom extends the tape line that is being adjusted by the man in the foreground, below. Measurements are thus transferred from the model to the actual work.

put forward in favor of the memorial was that it would promote tourist trade. But, because the site was within both the Harney National Forest and a state game refuge, it was necessary to secure authority to proceed from the Congress of the United States and from the State Legislature of South Dakota. This was done in 1925, and the Mount Harney Memorial Association was organized with the governor of the state at its head.

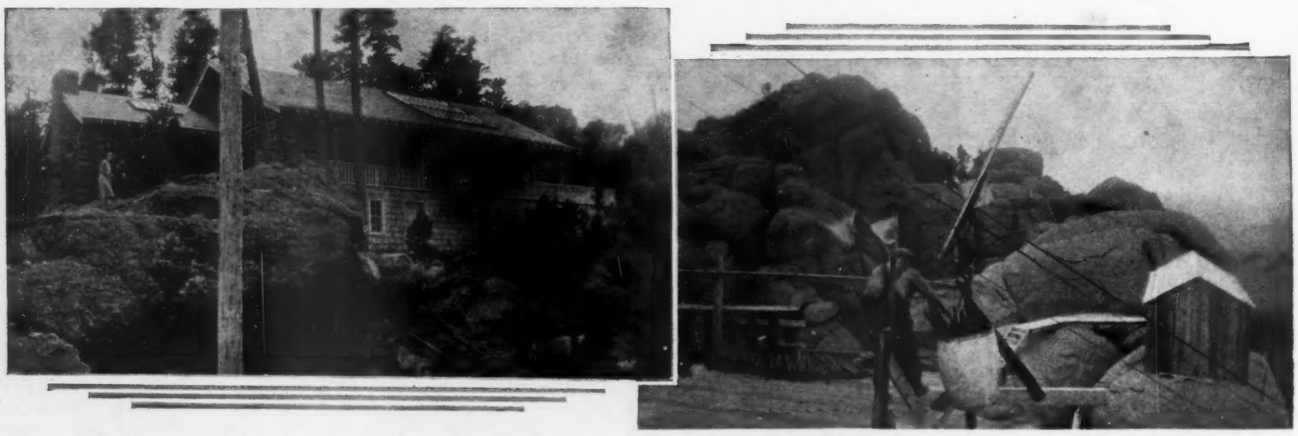
In January, 1927, this association was reorganized, and in March its executive committee signed a contract with Mr. Borglum. Solicitation of funds began, and before the year was out $54,000 in cash was in hand. One of the first substantial contributions came from Charles E. Rushmore, of New York, for whom Mount Rushmore had been named more than 40 years before.

All this time there had been a growing feeling that the undertaking was really of countrywide significance and interest, and that it should be officially adopted as a national memorial. The presence of President Coolidge in the Black Hills during the summer of 1927 helped make this feeling an accomplished fact. He was the principal speaker at the dedication of the mountain to the purpose intended in August of that year. At the conclusion of the ceremonies he accepted an invitation to write the history to be carved there and also pledged his aid in the furtherance of the work.

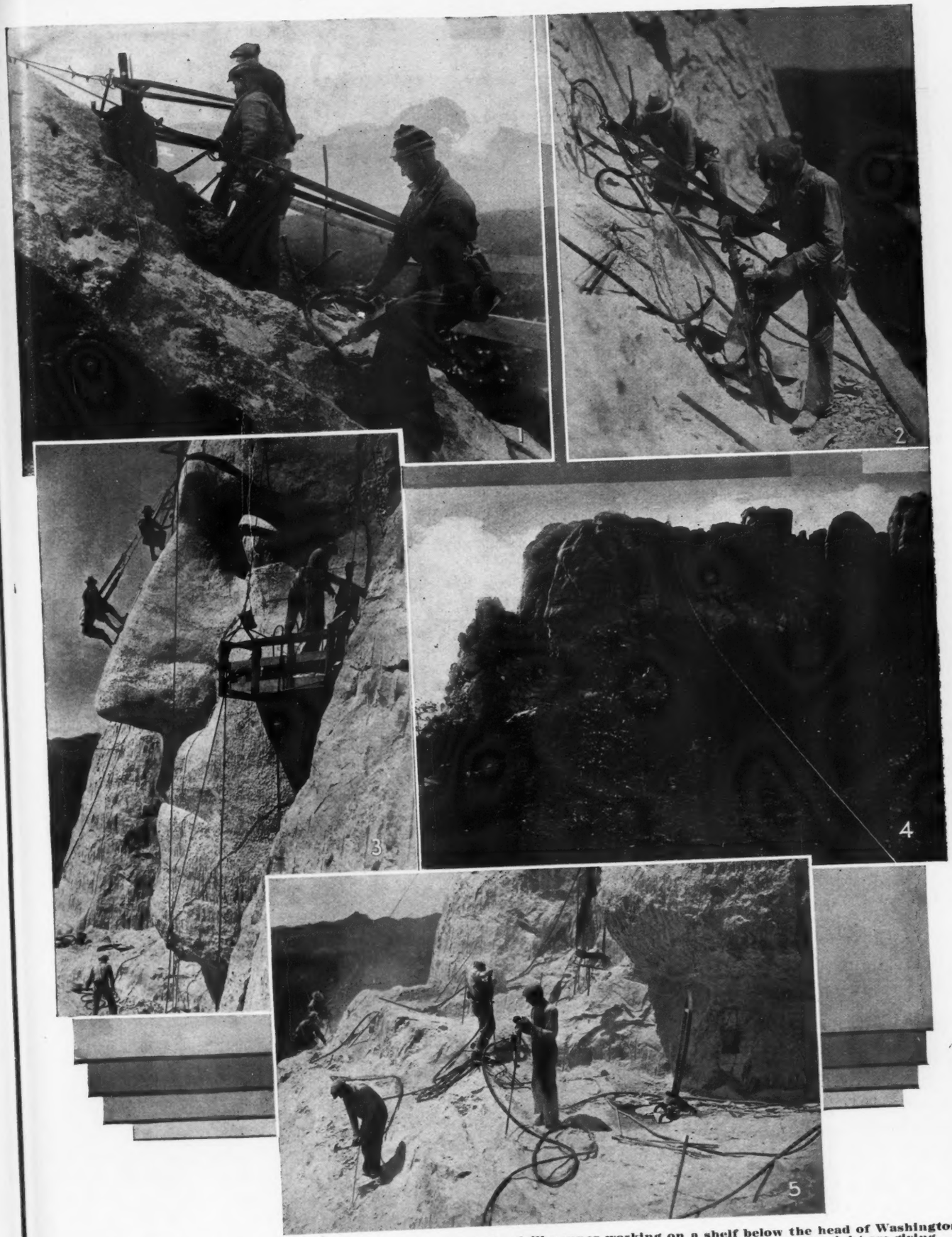
Early in 1929, the Congress approved an act creating the Mount Rushmore National Memorial Commission of twelve members to assume charge of the work. The act appropriated a sum not to exceed $250,000 for the memorial, to be matched dollar for dollar by funds from other sources. The bill also provided that no charge should ever be made for viewing the memorial. So much for the history of the memorial. As for the motives of the sculptor and what he hopes to accomplish, we can quote Mr. Borglum:

"A monument's dimensions should be determined by the importance to civilization of the events commemorated. We are not here trying to carve an epic, portray a moonlight scene, or write a sonnet; neither are we dealing with mystery or tragedy, but rather the constructive and dramatic crises in our amazing history. We believe the dimensions of national heartbeats are greater than village impulses, greater than city demands, greater than state dreams or ambitions. Therefore, we believe a nation's memorial should, like Washington, Jefferson, Lincoln, and Roosevelt, have a serenity, a nobility, a power that reflects the gods who inspired them and suggests the gods they have become."

Of sculptured mountains, Mr. Borglum says: "Too little of civilization lasts into tomorrow and tomorrow is strangely the enemy of today. Each succeeding civilization forgets its predecessor, and out of its body builds its homes, its temples. I want, somewhere in America, so far removed from succeeding, selfish, coveting civilizations, a few feet of stone that bears witness, carries the likenesses, the dates, a word or two of the great things we accomplished as a nation, placed so high it won't pay to pull down for lesser purposes. Hence, let us place there, carved high, as close to heaven as we can, the words of our leaders, their faces, to show posterity what manner of men they were. Then breathe a



Left—Sculptor's studio, below the cliff, which will later become a museum. Right—The "steel monkey" receiving a supply of sharpened drill steels via the aerial tramway.



1—Drillers using R-12 "Jackhamers." 2—A powderman and a drill runner working on a shelf below the head of Washington. 3—Mr. Borglum, in the center, inspecting the work on the 18-foot nose of Washington. The men at the right are giving the surface its final touches with pneumatic "bumpers." 4—Mount Rushmore, as it looked when the work was being started. The white line indicates the aerial tramway erected to transport supplies to the cliff. 5—A crew at work 60 feet down from the top of the cliff. Washington's chin, as roughed out, is seen at the upper right.

The partly completed head of Washington. At the left the rock is being roughed out preliminary to carving the head of Jefferson.

prayer that these records will endure until the wind and rain above shall wear them away."

In the arrangement of the figures, Jefferson will come first on the left by virtue of his authorship of the Declaration of Independence. Washington is given next place as the framer of the Constitution and for his numerous other services to the nation. As the preserver of the country's unity when internal warfare came, Lincoln will be placed next. On the extreme right will be Roosevelt, in recognition of his completion of the Panama Canal and fulfillment of the dream of Columbus for a direct route between the eastern and western oceans. Each of these figures will be on the scale of men 465 feet high if completed from head to foot.

Approximately 150 feet to the right of the group, on a perpendicular face of rock, 80 by 120 feet, will be the history. In outline, this tablet will take the form of the area that comprised the Louisiana Purchase. Running down the left-hand side of the tablet will be, in large figures, outstanding dates in the Nation's history. Mr. Coolidge will submit a final draft of the history to the Memorial Commission at its annual meeting this month.

The site of the memorial is in the highest area between the Rocky Mountains and the Atlantic Coast. It is about 30 miles from Rapid City and within three miles of the mining camp of Keystone, from which a temporary road was built for construction purposes. The cliff that is being carved rises abruptly from a canyon. The lower slopes are wooded with pine trees: above them the rock extends upward almost perpendicularly. The top of the group of figures will be some 500 feet higher than the rustic building which houses the sculptor's models and which will serve as a museum and observation point upon completion of the memorial.

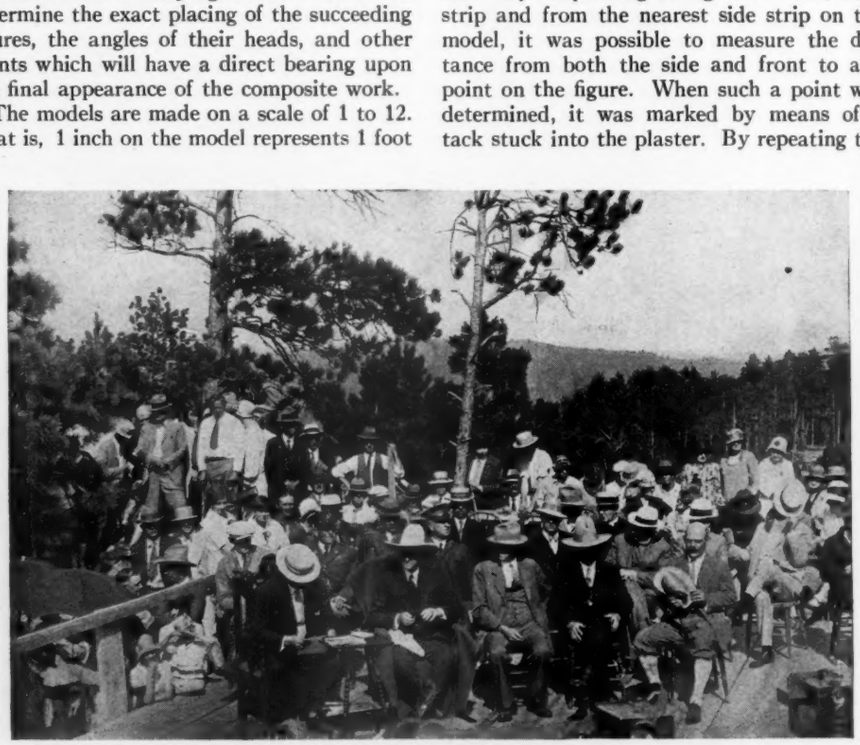
The actual work of carving the memorial is being done with tools operated with compressed air. At the time the site was visited, September 1, between 5,000 and 6,000 tons of rock had been blasted from the cliff. The head of Washington was then being completed, the head of Jefferson had been roughed out, and a start had been made in planing off the rock face that is to bear the historical inscription. Nothing has yet been done on the figures of Lincoln and Roosevelt—in fact, their exact locations are yet to be determined.

The first step in sculpturing the figures is the preparation of models. These are done in plaster of Paris. In this case, the making of the models immediately precedes their use. Mr. Borglum began with the head of Washington, as that was the first of the group to be cut from the rock. He has now added the head of Jefferson. When these two have taken form, he will model the head of Lincoln. By proceeding in this manner he is able to study the cliff as the work progresses and to better determine the exact placing of the succeeding figures, the angles of their heads, and other points which will have a direct bearing upon the final appearance of the composite work.

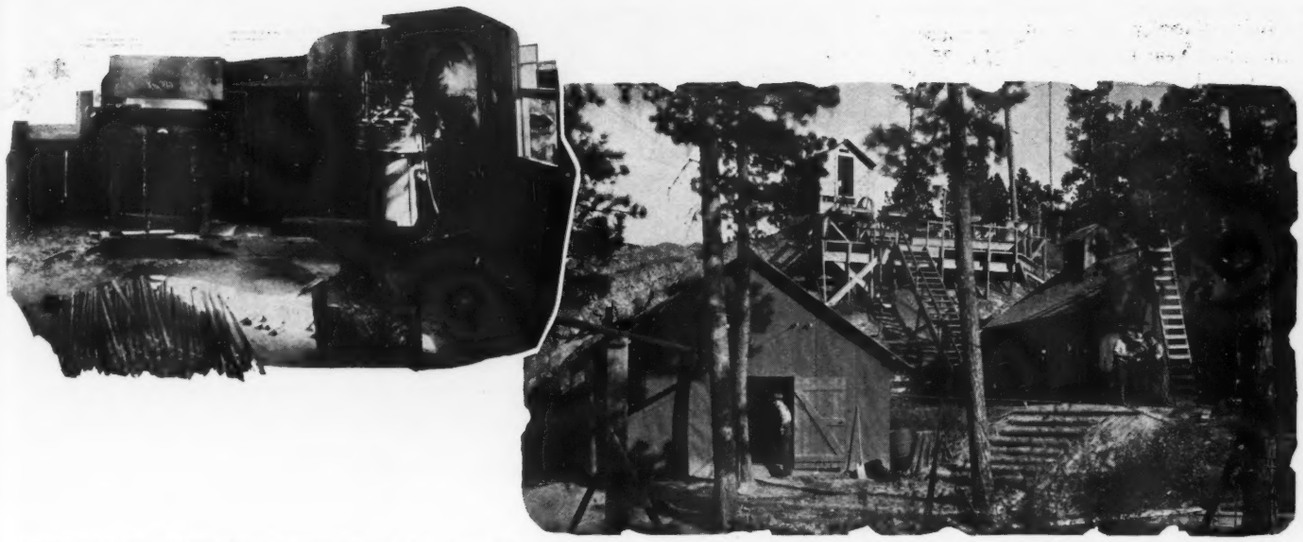
The models are made on a scale of 1 to 12. That is, 1 inch on the model represents 1 foot on the cliff. This simplifies calculations in transferring measurements. To effect this transfer, and thus guide the workmen, two methods are used. For roughing out the head of Washington, a protractor was mounted horizontally on top of the model of the head. Directly back of the center of the arc, opposite the 90° mark, was placed a pivot, to which was attached one end of a metal rod which extended outward across the arc of the measurement scale and over the head.

As soon as it was determined where the top of the head was to be and at what angle the face would look out from the cliff, a large metal protractor was set in the rock in a position corresponding to that on the model. An upright pipe was erected at the pivot point and a diagonal run from it to support the boom extending out over the cliff and corresponding to the rod installed on the model. By attaching a string with a plumb bob at its end to the metal rod on the model, it was an easy matter, by moving the rod around the arc, to measure the horizontal distance in inches from any point on the string to the nearest point on the model. By using the larger apparatus on the cliff and substituting feet for inches, the amount of stone that had to be cut away at any point was quickly determined.

After the figure had been roughed out of the stone, a different system was employed for completing the work. A strip of wood was mounted horizontally across the forehead of the model, with two other strips at the sides of the head meeting the first one at right angles. Together, they formed three sides of a square. A similar figure was constructed in a corresponding position on the partly completed head on the cliff, using angle irons for material. By suspending strings from the front strip and from the nearest side strip on the model, it was possible to measure the distance from both the side and front to any point on the figure. When such a point was determined, it was marked by means of a tack stuck into the plaster. By repeating the



Former President Coolidge dons a 3-gallon hat to dedicate the cliff to memorial purposes. Mr. Borglum is seated on the extreme right of the front row. This picture was taken in August of 1927.



Left—Interior of the blacksmith shop, showing a No. 25 oil furnace and a No. 34 sharpener. Right—Compressor house and blacksmith shop. Above them is seen the lower terminal of the aerial tramway that runs to the cliff.

process on the cliff, and marking the amount to be cut, the work proceeded with complete assurance that the dimensions of the figure in rock would be closely proportional to those of the model. This point system is said to have been used by sculptors down through the ages.

For roughing out the figures and for semi-finishing work, "Jackhamer" drills are used. These machines are of the R-12 type and of the lighter BAR-33 type. Down holes are mainly required for the roughing-out work. The maximum depth of the holes is 40 inches. Ordinarily, a row of holes is placed so as to permit shooting off 30-inch slabs up to 4 feet in thickness. The greatest horizontal cut called for thus far was about 30 feet, this being under the chin of Washington's head. Blasting is done with 40 per cent gelatin dynamite in cartridges 7/8x8 inches. Firing is done electrically.

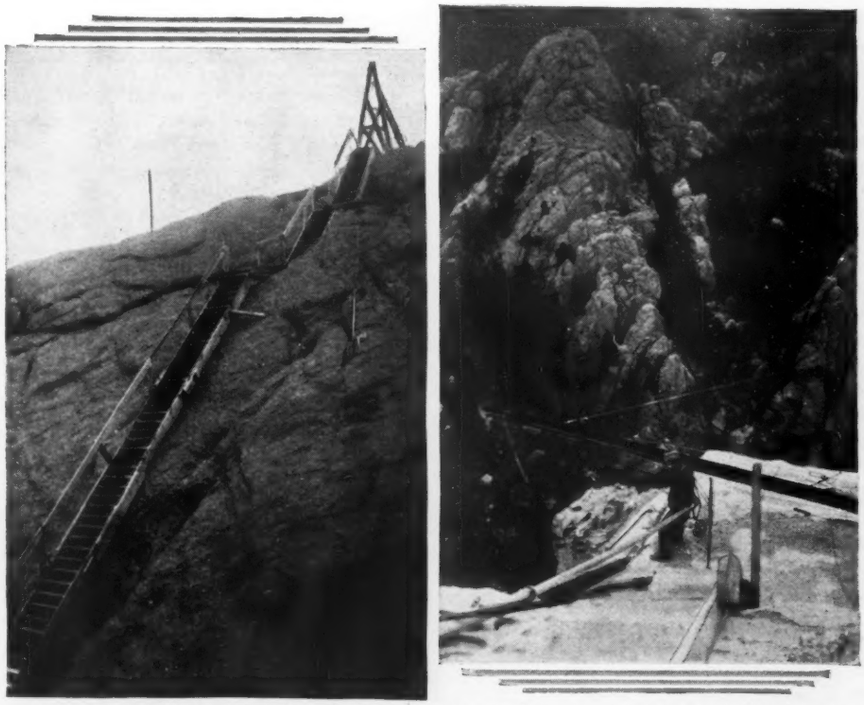
After a figure has been roughed out, greater care in drilling is called for and no blasting is done. The final 6 inches of material is removed entirely by tools. To accomplish this, closely spaced "Jackhamer" holes are drilled perpendicular to the surface and to the depth desired. The rock between these holes is then broken off with plug drills using moil-point steels. Both these operations are shown in the accompanying illustrations. The final smoothing off of the rock surface is done with Dallett hand surfacers, a small pneumatic tool used in the stone-working industry. These tools are fitted with a small 4-point bit familiarly termed a "bumper".

The Mount Rushmore granite is a gray, fine-grained stone that is quite uniform in texture. This, and the fact that it is practically free from fractures, promotes ease and speed in working it, considering that it is a hard rock. The granite weathers to a pleasing brown color, free from stains. Estimates have it that the memorial will endure as long as 500,000 years before erosion effaces it.

The work on the cliff calls for real steeplejack methods, as can be seen from some of the illustrations. Practically all the operations are carried on by men suspended in "harnesses" devised by Mr. Borglum. Each harness is suspended on a wire cable from a winch in a shed on top of the cliff and bears a number. When a workman wishes to be moved up or down, he calls out his number and gives his directions. The winch controlling his cable is maneuvered accordingly. The winches are manually operated. A "steel monkey", traveling about the cliff in a harness, delivers steel, drinking water, etc., to the men at work. He also relays orders coming from workers who are too far removed to be heard at the top. Despite the rather hazardous nature of the work, there has been no serious accident.

Most of the workmen are recruited from among the miners of the section. The size of the force varies widely from time to time. The maximum number that has thus far been employed was 40, working in two shifts. The men get to and from their labors by means of a footpath and a wooden stairway that lead up a ravine and thence up the rear of the cliff. An electrically operated tramway, 1,300 feet long, transports drill steel and other supplies to the work from the valley below.

The compressor house is located in the valley near the lower terminal of the tramway. The compressors in use are two Ingersoll-Rand Class ER-1 machines, short-belt driven from motors. One has a piston displacement of 386 cubic feet of free air per minute and the



Left—The final stage in the climb the workmen have to make to reach the scene of their labors. Right—The "steel monkey" acts as relayman in signaling the top to move one of the workmen about on the cliff below.

other of 528 cubic feet. A 4-inch line delivers air to the cliff. Near the compressor house is a blacksmith shop containing a No. 25 oil furnace and a No. 34 sharpener for reconditioning drill steels.

During the progress of the work, Mr. Borglum makes his home in Rapid City, from where he makes frequent trips to the scene of operations. W. S. Tallman, who has assisted the sculptor in some of his previous work, is serving as superintendent. The Mount Rushmore National Memorial Commission, appointed by Presidents Coolidge and Hoover, is composed of the following: John A. Boland, Rapid City, S. D.; Charles R. Crane, New York; Joseph S. Cullinan, Houston, Tex.; C. M. Day, Sioux Falls, S. D.; D. B. Gurney, Yankton, S. D.; Hale Holden, Chicago; Fred W. Sargent, Evanston, Ill.; Frank O. Lowden, Oregon, Ill.; Julius Rosenwald, Chicago; Mrs. Lorine Jones Spoonts, Corpus Christi, Tex.; Royal C. Johnson, Aberdeen, S. D.; and William Williamson, Rapid City, S. D.

(*Photographs by F. W. Byerly*)

PAPER MILL HANDLES WHITE CLAY PNEUMATICALLY

PAPER mills are consumers of large amounts of the white clay that serves as a loading material or filler for paper of all grades. Much of this clay for use in the United States has come from England. Latterly, however, an eastern producer has found a domestic source of supply that is highly satisfactory; that can be delivered at the plant in box cars at less cost than can the foreign commodity; and that is easier to handle pneumatically because it is considerably drier than the English clay.

At the mill in question, the dry, powdery material is being handled in bulk in a thoroughly dustless manner at an average rate of 10 tons per hour. The 3-inch suction line of the pneumatic system runs the length of the unloading platform so that any of the cars on the siding can be emptied without switching. From the cars the clay goes to a receiving station, whence it is fed by gravity direct to the mixer or is deposited for storage, by way of screw conveyors, in the basement of the plant. The receiving station and the vacuum pump and its driving motor are located immediately above the basement storage. From this point the material is drawn by suction through a second line leading to the mixer. Storage space is also provided on the top floor of the building so that the mixer can, if preferred, be fed by gravity.

The flexible connecting hose and nozzle of the system are of the same diameter as the suction line. The vacuum pump has a maximum unloading capacity of 12 tons per hour, and is driven by a 40-hp. motor. Although the moisture content of the clay has run as high as 4 per cent, it has in no wise interfered with the performance of the pneumatic conveyor, which is doing its work quickly, economically, without raising objectionable dust, and with little if any wastage.

Left—One of the caissons in position. Right—Diver getting ready to descend. The pneumatic scaling hammer used by him to break up the hardpan was fitted for the unusual work with a small spadelike tool.

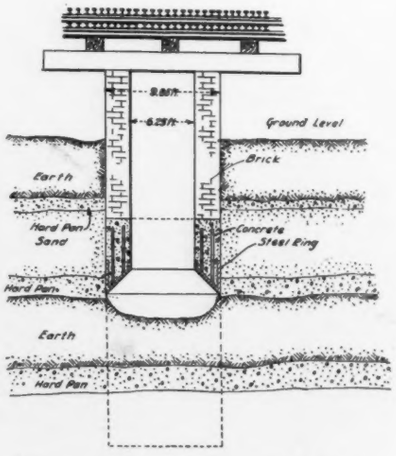
PNEUMATIC SCALING HAMMERS DO UNUSUAL WORK

PNEUMATIC scaling hammers are generally called upon to do just what their name implies—that is, remove scale, rust, paint, etc., from metal surfaces or do any light chipping and calking. In other words, they are not exactly heavy-duty tools. However, hammers of this description, if of sturdy construction, are apparently capable of standing up under conditions and to work for which they were not intended, as evidenced by the following first-hand information received from Argentina.

In building foundations for the Neuquen Bridge, which spans a river bearing the same name, the Buenos Aires Great Southern Railway encountered some difficulty in sinking the caissons. These were of the open type and for the most part of brick construction—the lowermost end, carrying the steel cutting edge, being of reinforced concrete. The walls of the caissons were approximately 21.5 inches in thickness, leaving an inside diameter of 6.25 feet. This was ample for the operation of a clamshell bucket, which was used to do the excavating.

The formation penetrated consisted of strata of earth and sand with interposing layers of *tosca* or hardpan. It was this material that caused the trouble, and which necessitated a change in procedure right from the start. To facilitate getting the caissons down to the predetermined level, the weight of each was, as is common practice, augmented by placing a heavy load—in this case consisting of old rails—on top of it. But even with a maximum burden of 300 tons the cutting edge could not be forced through the hardpan. In order to accomplish this it was found necessary to break up that resistant material before caisson-sinking could proceed. And here is where air-operated scaling hammers saved the day.

The hammers used were of the N-1 type, which weighs but 7 pounds and was not designed by the Ingersoll-Rand Company for underwater service. Just the same, they stood up to the work well; and with the exception of the substitution of a flat spadelike tool for the normal scaling tool the hammers were not modified in any manner. It should be mentioned, however, that the exhaust air was discharged some distance away from each unit through a hose connection. This was done so as to prevent agitating the water around the tool, because the rising air bubbles would have impeded the diver at his work. As the accompanying line drawing shows, strata of hardpan were encountered at various levels at the bridge site, but the maximum depth to which the divers had to descend to clear the way for the caissons was close to 33 feet.

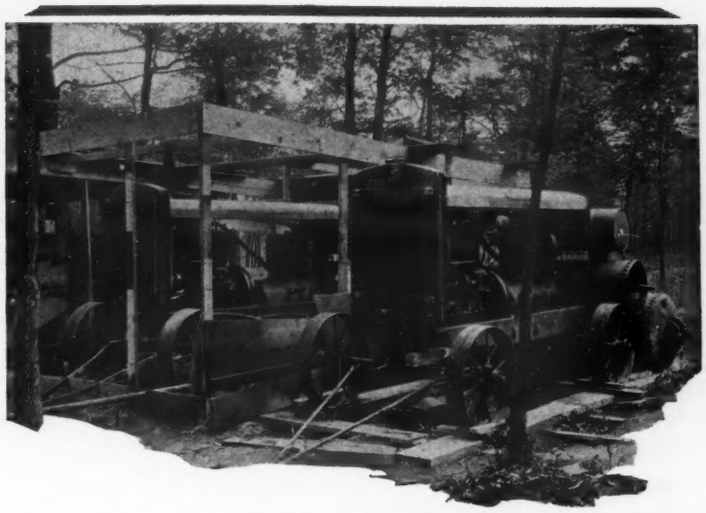


Vertical section of the type of caisson used, illustrating the frequency with which hardpan was encountered on the job.

The formation of ice on airplane wings is a dread menace of which a pilot is not infrequently unaware until it is too late to avoid an accident. Many planes have in the past been brought to earth because their lifting power was not equal to the extra dead weight thus imposed upon them. However, if reports be true, this bugaboo of flying can now be guarded against even if it cannot be avoided. The United States Bureau of Standards is said to have developed an apparatus that warns the aviator by the shining of a red light on his instrument board when conditions are such as to favor the formation of ice. He can then take proper precautions—either making a landing or proceeding at a lower altitude where the air is warmer. Experiments have shown that ice will form on wings at temperatures between 26 and 32°F. when the atmosphere through which the machine is passing is saturated with water vapor.

Big Water Tower Built in Milwaukee for Booster Service

By D. A. SLATTERY



The pneumatic riveting hammers used in the erection of the tower and its superposed tank were supplied with compressed air by these two 9x8-inch portables.

THE City of Milwaukee, Wisc., has recently added to its assets an elevated steel water tower for which is claimed a double distinction: a record for capacity, and a record for erection time. The structure is believed to be the highest for its capacity ever built in the United States; and it was completed within eight months from the date upon which its location was definitely established.

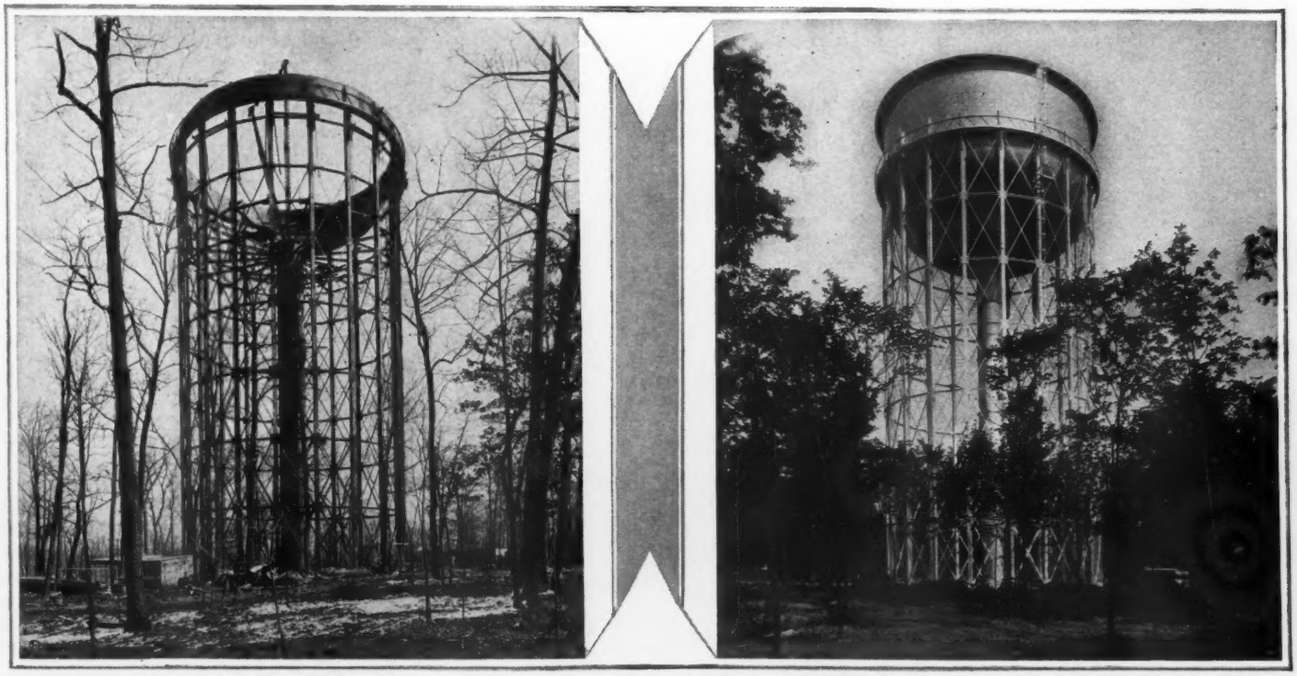
The tower is situated in a picturesque section of Jackson Park in the southwestern part of the city that has been undergoing considerable expansion. There its contained water will serve to boost the pressure for the South Side during the peak demands of the summer months. At this season of the year the consumption of water in that community of homes and gardens is so heavy that without this auxiliary the pressure would be too low for safety, below that adequate for fire-fighting.

The story of the tower's erection is one indicating careful planning and prompt action. On November 12, 1929, the site was decided upon and approved by the municipal authorities; and within the next three weeks the necessary surveys were finished; load tests of the soil were made; deep test borings were taken; and plans and specifications were drawn up ready for building operations. Bids on the concrete foundation and steelwork were accepted on December 2; and this was followed immediately by the laying out of the distribution system. On the last day of that month bids were received and contracts awarded for the delivery of water pipe, gate valves, and other associate supplies.

Actual work on the undertaking was begun on December 9, and by February 1, 1930, the concrete foundation had been laid. A total of 1,200 cubic yards of earth was excavated for this purpose, and 654 cubic yards of concrete were poured. While this part of the job was in progress, the detailed shop drawings of the tower and its surmounting tank were being carefully checked.

The beginning of the New Year witnessed the delivery of the first load of steel; on February 2, erection of the hoist, derrick, toolshed, and other essential equipment was started; and five days later saw the first supporting column in position. From that time on the structural work proceeded rapidly and without delay. In all, 715 tons of steel went into the framework of the tower and into its tank, and approximately 50,000 rivets were required to bind the parts and plates together.

During the last week in June—after the completed tower together with the water pipe, gate valves, and blow-off lines had been thoroughly tested—the structure was pronounced to be in accordance with the specifications and filled with water. The entire project was carried out under the



Left—The 143-foot tower with the first course of plates for the tank in place. Right—The finished structure with its 1,500,000-gallon tank that assures Milwaukee's South Side an ample supply of water during peak periods.

personal supervision of Mr. Joseph P. Schwada, city engineer, assisted by Mr. Herbert H. Brown, engineer in charge. It was constructed for the municipality at a cost of $142,000.

From the ground to the top of its great cylindrical tank the tower rises well above the tops of the surrounding trees to a height of 190 feet. The tank is 79 feet in diameter; has a capacity of 1,500,000 gallons of water; and is supported by twenty suitably stiffened 14-inch H-columns. Its roof is of copper-bearing steel plates, 3/16 inch thick, resting on trusses and purlins. At a point 23 feet up from the bottom of the tank, or 143 feet above ground level, is an encircling balcony, 36 inches wide, for inspection purposes. The riser pipe, of ½-inch steel plate, is 10 feet in diameter.

The equipment used in the construction of the tower consisted of two Ingersoll-Rand 9x8-inch portable, gasoline, air compressors and of I-R riveting hammers. The concrete foundation was laid by the Parkinson Construction Company, of Milwaukee, and the steel tank was built by the Pittsburgh-Des Moines Steel Company of Pittsburgh, Pa.

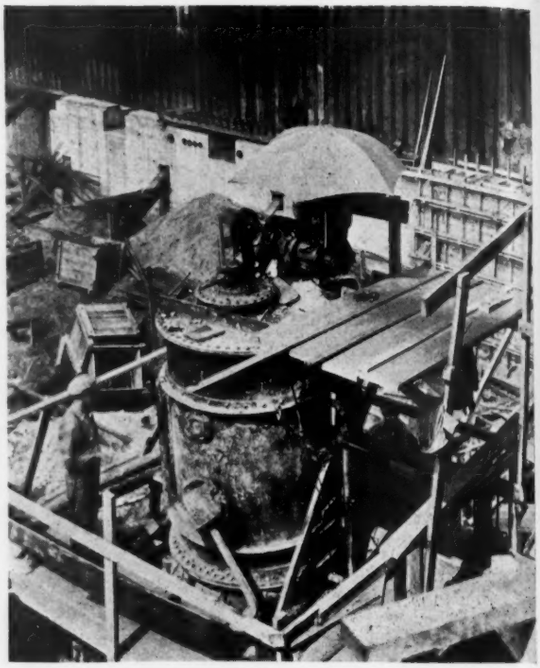
AIR HOISTS IN FOUNDATION WORK

INDIVIDUAL hoisting equipment for air locks used in caisson-sinking has been introduced by the well-known contracting firm of Booth & Flinn, Ltd., on the foundation work for the Gulf Building in Pittsburgh, Pa. This building is now in course of erection, and will be the city's tallest structure. It will rest upon concrete piers that have had to be carried down a hundred and more feet to bed rock lying 40 feet below water level.

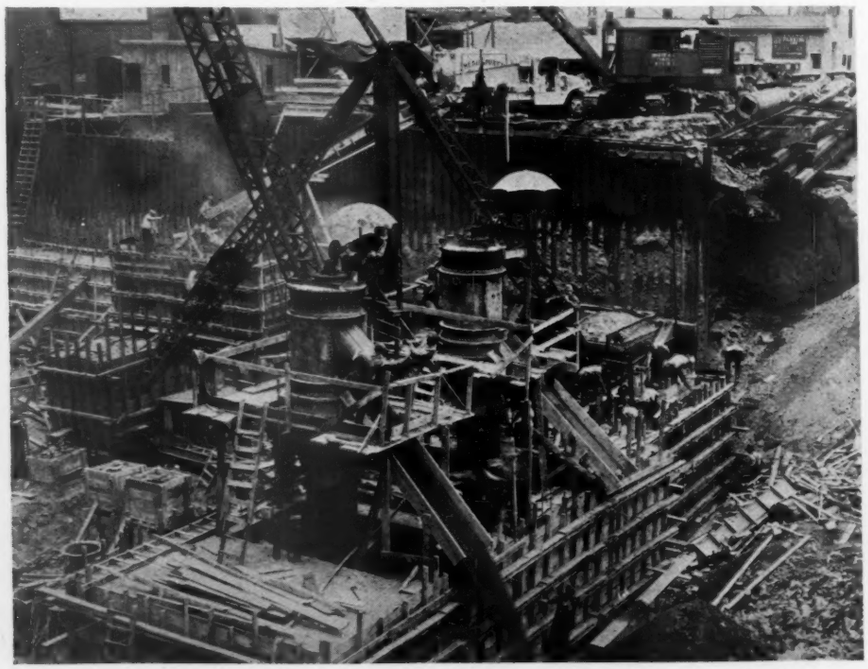
Fourteen caissons in all have been sunk, and in each case the buckets used to bring the spoils to the surface were handled not by means of the accustomed derrick but by a "Utility" air hoist. By thus providing each lock with its own hoist the dumping of the excavated material could be effected without the delay sometimes incident to the use of one derrick for a number of caissons, as is common practice.

At the beginning of the operations the contractor put four pneumatic hoists on the job for this purpose. These proved so satisfactory that three more were installed two weeks later. These seven hoists, which were of the Ingersoll-Rand Company's EU Type, did all the work of raising and lowering the buckets in removing the muck from the caissons. The loads handled by them totaled as much as 2,000 pounds or thereabouts—the buckets, themselves, weighing 475 pounds each. Compressed air at a pressure of 100 pounds was delivered to the hoists.

According to the contractor, the hoists were on the job throughout the 24 hours of the working day and for a period of about four months. In all that time not a minute's holdup in caisson-sinking was experienced owing to hoist trouble. Some little difficulty was at first encountered with cable-winding by reason of the fact that the stationary 12-inch shieve block was but 24 inches away from the drum. This was too close, and necessitated the employment of an iron bar to guide the cable on to the drum. Experience, however, proved that this could be avoided by allowing an interval of 3 feet between the hoist and the block or by a swivel-pulley arrangement.



One of the seven "Utility" air hoists that were used by Booth & Flinn, Ltd., to bring the muck out of the air locks required in sinking the foundation piers for the Gulf Building in Pittsburgh, Pa.



Dumping a bucket of spoils that has just been brought up by the air hoist.

MOUNT VICTORIA TUNNEL DRIVEN BY UNUSUAL METHOD

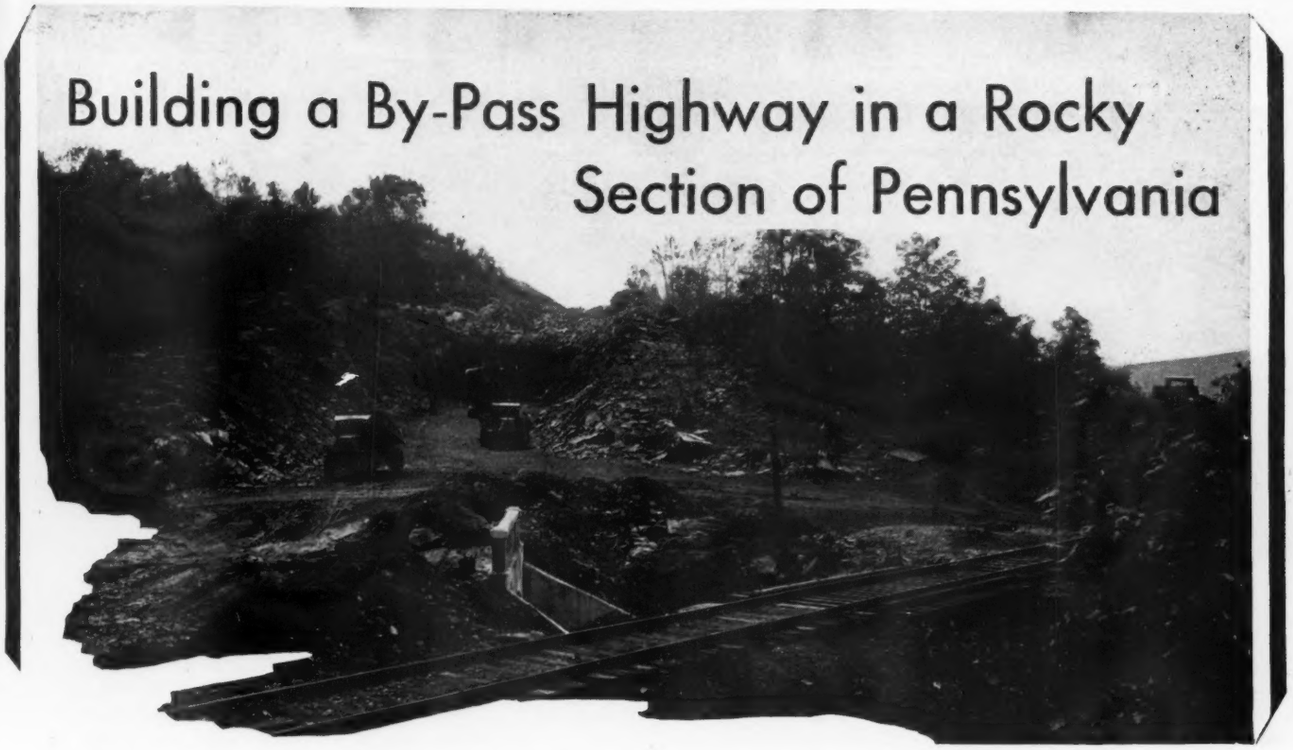
THE recent announcement of the holing through of the southern section of the Mount Victoria Tunnel, in Wellington, New Zealand, is of more than just passing interest because of the unusual way in which that traffic artery is being driven. The method is said to be peculiar to that part of the world, and consists of driving simultaneously two parallel tunnels—the center core being excavated subsequently.

In this case the tunnels were each 8 feet wide and 12 feet apart, and the work was advanced from eight headings, four on each side of the intervening rock barrier. This barrier is removed in benches—enough of it being left to serve as platforms for the concreting gangs that follow in the wake of the drillers and muckers. The concrete is placed pneumatically.

From portal to portal, the Mount Victoria Tunnel—which is named after the mountain that it pierces—is 2,045 feet long, and throughout much of its length timbering had to be resorted to. Work on the project was started about the middle of last December, and the expectations are that the tunnel will be ready for traffic in February of 1931—four months ahead of the time specified in the contract.

A student at the University of Naples claims to have succeeded in constructing a machine that enables him to derive electrical energy from the atmosphere. Details of the apparatus, which is said to be quite simple in design, have not been revealed; but accounts have it that he has produced current sufficient to light a lamp.

Building a By-Pass Highway in a Rocky Section of Pennsylvania



Construction of This New Road Illustrates the Growing Practice to Avoid Populous Centers in Planning Routes for Through Traffic

By R. G. SKERRETT

EVERYWHERE throughout the length and breadth of Pennsylvania, the State Highway Department has provided a network of fine interconnecting roads for the use of automobilists and as routes for long-distance bus and motor-truck service.

In the construction of these roads the highway authorities have drawn freely upon the best engineering skill and have utilized every modern development that would contribute to the permanency and to the effectiveness of these routes. The responsible officials are keenly alive to the economic importance of such highways, and they are equally aware of what they represent as a pleasurable convenience to both touring and resident motorists.

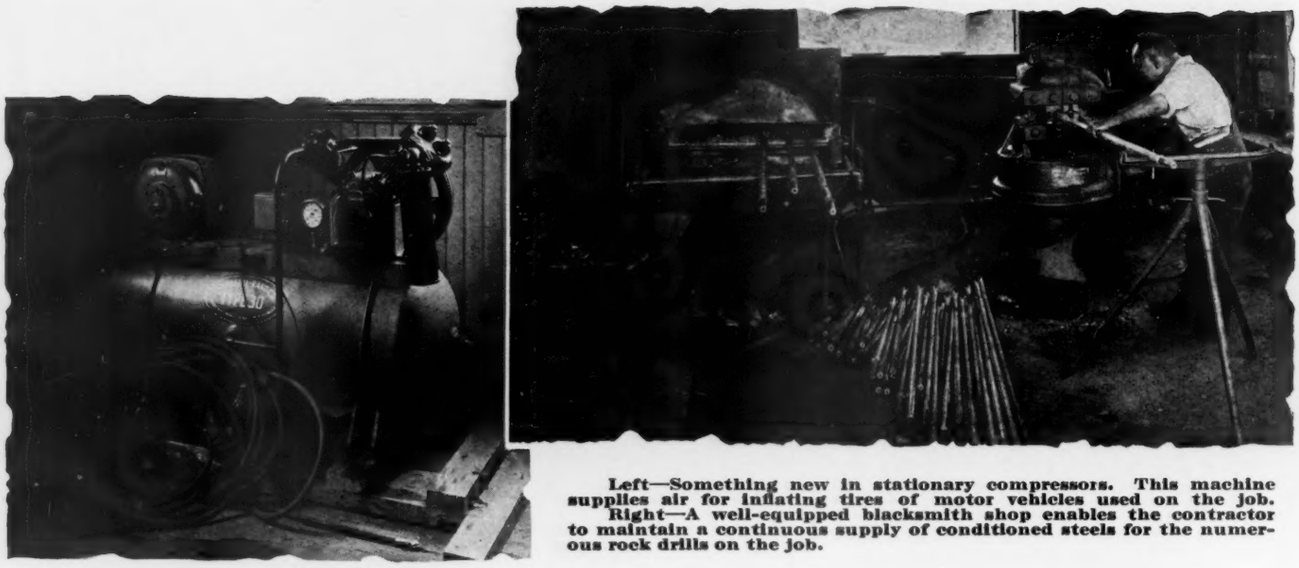
The general public benefits in many ways through these present-day roads; but only a small percentage of the public appreciates any of the principles underlying the planning of up-to-date highways, and still fewer have more than a very elementary knowledge of the mechanical equipment now employed in constructing them. In short, each new highway is more or less a direct reflex of the influence exerted by continually improving motor vehicles. It is because of this fact that the art of highway building is in a state of ceaseless flux.

It was not so many years ago that the roadbuilder, with draft animals to be considered, had first to give heed to grades so that uphill pulls would not be too exhausting; and, because the hand drilling and blasting of rock was tedious and costly, the routes were usually traced around obstacles and followed the line of least resistance. Often they were much longer, although easier to travel, than they would have been had the engineers cut their way boldly through the interposed obstructions that interfered with more direct courses.

To those familiar with the subject it is known that the appearance of air-driven rock drills, portable compressors, and power shovels radically altered the problem of the highway engineer; and, as a consequence, he tackled unhesitatingly great masses of rock and earth in carrying his road forward despite natural conditions that would have forced his predecessors to resort to wide or sharp curves, if not to detours. With the realization that he could thus battle with Nature, highway planning became largely a matter of making every important roadway the shortest or straightest possible route between neighboring communities—the object being to link the center of each place with the center of the next nearest place or places. This was a desirable arrangement when the volume of motor-vehicle traffic was comparatively small and largely made up of vehicles belonging to the neighborhood.

The ever-widening range of tourist travel gradually emphasized the unwisdom of directing through traffic into the heart of a busy town or city where transient vehicles might add to a hampering degree to the resident or regional normal volume of traffic—thus slowing up the general movement and, possibly, augmenting the number of accidents. The gravity of this situation grew with the increasing speeds of motor vehicles. Highway engineers came to recognize that one solution of the problem lay in the building of by-pass roads that would skirt populous centers and permit

For block-holing and for clearing away isolated ledges S-49 "Jackhamers" have been found highly efficient.



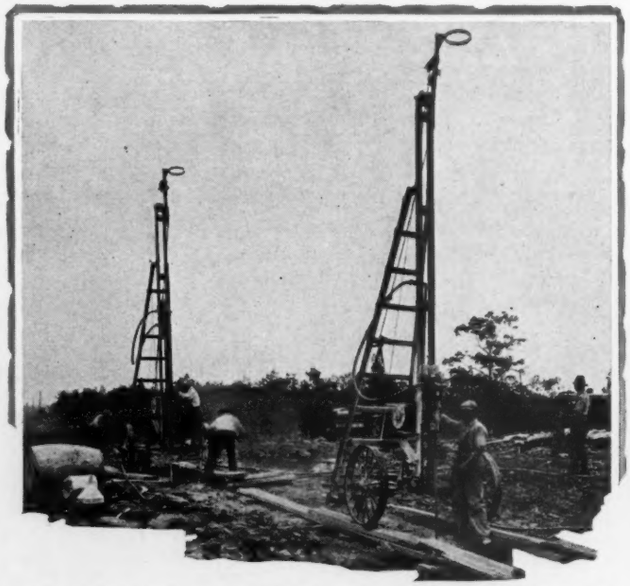
Left—Something new in stationary compressors. This machine supplies air for inflating tires of motor vehicles used on the job. Right—A well-equipped blacksmith shop enables the contractor to maintain a continuous supply of conditioned steels for the numerous rock drills on the job.

through traffic to go hastening on its way—thus avoiding entrance into those towns and cities and the swelling of their accustomed traffic streams. Indeed, by-pass routes are yearly becoming more necessary in many parts of the United States, because they contribute both to safety and to the fuller utilization of the capabilities of modern motor vehicles engaged in covering long distances in the present acceptation of the term.

This article has been inspired by one of these by-pass highways that is now under construction in Luzerne County, Pennsylvania and which will extend between the industrial cities of Wilkes-Barre and Pittston. The road is located in the very heart of Pennsylvania's anthracite region. It will have a length of seven miles, and its paved surface will be 20 feet wide with a 10-foot shoulder on each side. Six miles of the highway will have a cement surface, while the remaining mile will be surfaced with bituminous macadam. The road will run from the town of Dupont—northeast of Pittston—to the suburbs of Wilkes-Barre. The line traced by it will permit motor vehicles to follow a route lying outside of both Pittston and Wilkes-Barre, and, incidentally enable them to avoid a number of intervening smaller places.

Wilkes-Barre and Pittston are in a semi-mountainous section of Pennsylvania; and many of the much traveled thoroughfares of the two cities have notably steep gradients that impose restrictions and extra careful driving when slippery. This physical characteristic, therefore, adds just so much to the desirability of reducing the volume of traffic by diverting long-distance vehicles to an outside highway. The new route is only one of many built or building by the Pennsylvania State Highway Department, and also just one more example of what is being done to provide for the fullest and safest use of modern motor vehicles of all sorts.

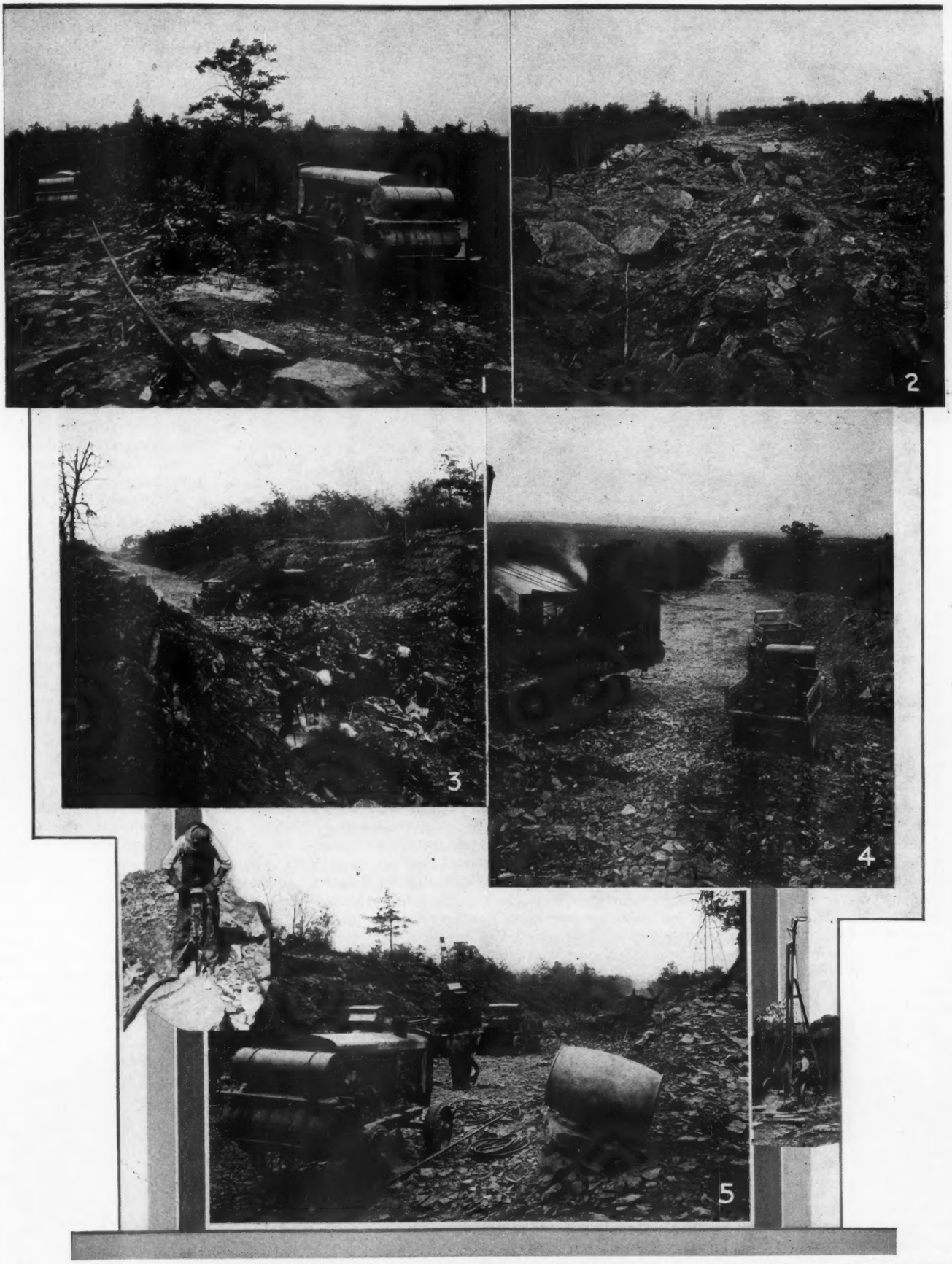
The Pittston–Wilkes-Barre by-pass traverses the very picturesque hill country to the eastward of those two communities. While much of it follows a straight line, a considerable section traces an easy wide curve that has a 2° sweep. Apart from its other advantages, the new road will be able to boast of scenic charms that are bound to appeal to sight-seeing and touring motorists. The work is being done by a well-known contractor, Raffaele Mazzoni; and the cost of the undertaking is $650,000. Building operations were started about the middle of July of the current year, and the contractor expects to finish the job some time in May of 1931. At present, progress is considerably ahead of the prearranged schedule. Undoubtedly, this favorable status of the project is largely due to the wise selection of mechanical equipment for the different phases of the work.



Two of the Type D Ingersoll-Rand wagon drills that are making fine records in excavating extensive bodies of rock.

While modern motor highways are built with far less regard to gradients than was the case when draft animals did most of the hauling, still the engineer finds it desirable today to flatten the gradient from time to time, especially when the natural contour of the country interposes rather short and steep climbs. Accordingly, the Pittston–Wilkes-Barre by-pass will be marked by a number of more or less deep cuts—cuts that go through formations consisting in the main of rock. In one cut, for instance, which is 600 feet long and has an average depth of 20 feet, the excavated material was more than 90 per cent rock. Even so, the whole job is at this writing approximately 60 per cent completed; and it is the contractor's expectation that the work of excavating, if the present rate of progress continue, will be concluded before the end of November. This is a fine showing in view of the conditions that have to be met. The rock encountered varies widely. Much of it is seamy shale, while at one point it is decidedly hard.

Some of our illustrations give a realistic idea of the character of the country traversed and also a grasp of the conditions under which much of the work has to be carried on. The prevalence of rock and the pronounced ruggedness of considerable sections along the route have made rock excavation the outstanding problem of the contractor; and this has been emphasized by the depths of the cuts needed at a number of places along the line. After a short period of pioneer work it became evident to the contractor and his able associates that rapid progress could be insured only by employing for the deep holes a type of rock drill that would combine both power and mobility. By mobility, in the present case, we mean facility in shifting quickly from point to point on a broken and extremely irregular surface. These requirements have



1—Two 10x8-inch portable compressors supplying air to rock drills at an isolated point in the route of the new by-pass highway. 2—This upheaval of rock is not the consequence of an earthquake but what air-driven drills and dynamite have done to prepare the way for the new road. 3—Where the new road cuts through nearly solid rock for a distance of 600 feet at an average depth of 20 feet. 4—Vista of a section of the road now under construction between Dupont and Wilkes-Barre which gives some idea of the character of the country traversed. 5—In the thick of it. Portable compressors, power shovels, and capacious motor trucks disposing of rock in a deep cut.

1—Caterpillar tractor equipped with a scraper: an efficient means of distributing and leveling rock for the road bed. 2—The steam roller discharges a specific and necessary service in roadbuilding work. 3—Power shovels have plenty to do in excavating and loading rock and earth—mostly rock.

been completely met by Type D, 3-wheel Ingersoll-Rand wagon drills.

Each outfit on the job is equipped with an X-71, blower-type drifter. The large blower tube with which each drill is fitted serves effectually to remove the cuttings from the drill hole—thus preventing jamming and, at the same time, increasing the performance of the machine. In the course of 8-hour shifts these drifters have repeatedly drilled as much as 328 feet; and twice during successive runs of 12 hours they have done 412 feet. Because of their 3-wheel mountings, the operators have found it a comparatively easy matter to shift the machines from one position to another. The holes are drilled on 4-foot centers and have a maximum depth of 20 feet; but this depth is not the limit that can be reached with wagon drills of this type.

The X-71 drifters are secured to slab-backs which move up and down on guideways formed of steel angle bars—the movement of the slab-back being controlled by a DU hoist on each outfit. When it is necessary to change a long drill steel, the steel is lifted into adjusting position by means of a hand hoist attached to the rear braces of the wagon mounting; and special facilities are provided for holding extra long steels in an upright position preparatory to inserting the shanks in the drills. It might also be mentioned that the slab-backs are arranged for the attachment of adjustable weights so as to insure at the bit the pressure that will best suit the rock to be drilled. Enough has been said to make clear the adaptability and the mobility of the wagon drills now doing fine work on the Pittston–Wilkes-Barre by-pass. These tools are the present climax of ten years of development and continual effort to make them fit for a wide range of drilling requirements. In some instances, where it has been desirable to drill toe holes to get out a mass of overlying rock, the wagon drills have been utilized to advantage—some of the holes being driven at an angle of substantially 45° from the vertical. This flexibility will be readily appreciated by those familiar with tasks of this kind and who may have been called upon to employ other machines for the work.

With the three wagon drills in use, the contractor has been able to get out as much as 2,000 cubic yards of rock at a blast; and most of the rock so moved has been broken up sufficiently for handling by the power shovels. Only a moderate measure of large pieces has had to be block-holed so that the rock could be disposed of by the shovels, of which there are five in service—namely, three Lorain, one Marion, and one Bucyrus-Erie. Four of these units have 1¼-yard buckets, while the remaining machine is equipped with a ¾-yard bucket. All block-holing is done with S-49 "Jackhamers"; and the same tools are used to do some of the drilling in isolated ledges. In this seamy rock the "Jackhamers" drill to a maximum depth of 15 feet. They can, however, put down deeper holes, if required.

The job is provided with a single, more or less centrally located, blacksmith shop. This shop is equipped with a No. 50 sharpener carrying an LP bit punch, a No. 26 oil furnace, and a No. 8 pedestal grinder—all Ingersoll-Rand products. The steel used—also an I-R commodity—is hollow and 1¼ inches in diameter. The bits range from 3 inches down to 2¼ inches. The latter diameter is the size of the final bit on 22-foot steels. The blacksmith shop sharpens daily about 100 steels; and the shop also conditions the steels used by the well drills. These machines were purchased at an early stage of the undertaking. They drill 6-inch holes.

The main supply of operating air is furnished by seven 10x8-inch Ingersoll-Rand portable compressors. These machines provide air for the rock drills and for the pneumatic equipment in the blacksmith shop. The majority of them—working singly or in groups, as occasion demands—are moved from point to point to supply air for the wagon drills and the "Jackhamers". In the office, at the Dupont end of the contract, there is a Type 30 compressor which is utilized principally to produce air for filling tires. Six Caterpillar tractors do scraper and other work; while earth and rock are transported by a fleet of eleven large motor trucks.

The nature of the task has gripped the imagination of Mr. Raffaele Mazzoni—familiar as he is with contract work of many kinds, and, as a consequence, he is continually in evidence here, there, and elsewhere on the job. In the successful execution of different phases of the contract he is ably aided by Fred G. Mazzoni, assistant to the contractor; Richard A. Porter, engineer; and William Smiley, master mechanic.

We wish to express our appreciation to various of these men for the information which has made this article possible.

The newest thing in automobile bumpers is built on the principle of the pneumatic tire. It has been put on the market in France, and consists of a slightly curved steel bar to which is attached a cylindrical rubber casing containing an inner tube that is kept under pressure.

Digging the trench for a water main that will cross beneath the by-pass highway.

Colorado Now Producing Travertine—An Aristocratic Building Stone

By ALLEN S. PARK

IT was the boast of the Emperor Augustus that he found a Rome of brick and left one of marble. Until his time, marble had been regarded as an architectural luxury. In the many new buildings which he conceived and executed, Augustus used large quantities of white Carrara marble from the quarries at Luna. In conjunction with this stone he employed travertine. This he secured at Tivoli, sixteen miles from the Eternal City and near the famous hot sulphur baths which Romans back to Agrippa visited following excessive indulgences in food and drink. These hot springs no doubt bear a close relationship to the waters responsible for the deposition of the stone that found the emperor's favor.

Down through the centuries since Augustus lived, travertine has been considered a choice stone in the Old World, and many of the most famous buildings in Rome are made up of it in whole or in part. England also has known it well, a notable example of its use being in Berkeley Castle. American architects were slow to adopt it, largely because no travertine of high quality was known to occur in this country. In recent years, however, there has been discovered in Colorado a deposit that compares very favorably with the Italian stone. This has now come into use in the western states, principally for decorative purposes, and is being so well received that its wider application seems assured. Meanwhile, increasing quantities of Italian travertine are being imported each year for use in cities along the Atlantic seaboard. Since the tariff on the foreign stone about offsets the difference in shipment-charges as between Colorado to New York and Italy to New York, the domestic stone can compete on a favorable price basis with the foreign variety even along the eastern coast.

The first important structure in the United States to contain appreciable amounts of travertine was the Pennsylvania Station, in New York City, in which the architect, Stanford White, specified it for interior walls, for steps, and for other purposes. Travertine was so little known in this country at the time that some of the New York newspaper writers called it "Tiber Marble, from the bed of the Tiber River in Italy." Apparently their mistake was due to the fact that the classical name of the stone is *Lapis Tiburtinus.*

Travertine admirably fills all the builder's requirements. It has beauty, strength, and durability. Whereas most marbles are cold and austere, and hence somewhat repelling, the straw-to-buff color of travertine and its soft luster give it a decided warmth that makes it desirable for inside use. Because of this quality it is being selected for bank interiors and for entrances, lobbies, and hallways of numerous buildings. In the construction of homes it is employed chiefly for mantels, lintels, and the like. In England, Ireland and Scotland, however, there are many dwellings near quarries of this sort that have walls of travertine throughout. Because of its lightness and its strength, travertine is particularly favored for arches and other vaulted structures. The Cloaca Maxima, the great sewer of Rome, is supported by arches of travertine every 10 feet.

When first quarried, travertine is soft enough to be readily worked: upon exposure it becomes hard and firm. It is claimed for travertine that it will outlast granite in any climate and under any circumstance. Rome exhibits many examples of its durability. The entire exterior of the Colosseum was built of it. This famous amphitheater remained intact for five centuries after its completion in 80 A. D. Theodoric, king of the Goths, had material taken from it for many buildings; and in aftertimes it became a veritable quarry from which Pope Paul II and his successors secured stone for papal palaces erected during the fifteenth and sixteenth centuries. Many of these structures are still standing, little impaired. In A. D. 7 an arch of travertine was constructed on the Tiber near the Ponte Sublicio. The stone was in such good condition in 1480 that it was used to make cannon balls.

Travertine is a variety of onyx which is deposited by hot water

This gateway to a Denver home is trimmed with Colorado travertine.

Travertine lends a distinctive tone to the entrance of this brick residence.

solutions containing carbon dioxide. Some authorities believe that the gas is in solution under pressure, and that travertine is deposited much in the same way as is boiler scale. It has not been clearly determined why some deposits are compact and crystalline while others are light and tufaceous like those now forming at the Mammoth Hot Spring in Yellowstone National Park. It seems reasonable to assume that the characteristic cellular or porous structure of most travertine is due to the escape of carbon dioxide from the partly consolidated deposit.

"All things considered," writes Prof. George P. Merrill in *Stones for Building and Decoration*, "it seems probable that the travertine varieties of onyx are products of deposition from hot springs carrying in solution, in addition to lime carbonate, small quantities of iron and magnesium carbonates. Furthermore, it seems probable that this deposition took place on the bottom of shallow pools, where the rate of escape of the gas was sufficiently retarded to allow the material to assume a compact and thoroughly crystalline texture. The cave marbles differ from the travertines mainly in the method of deposition, being cold-water deposits upon the walls and floors of limestone caves."

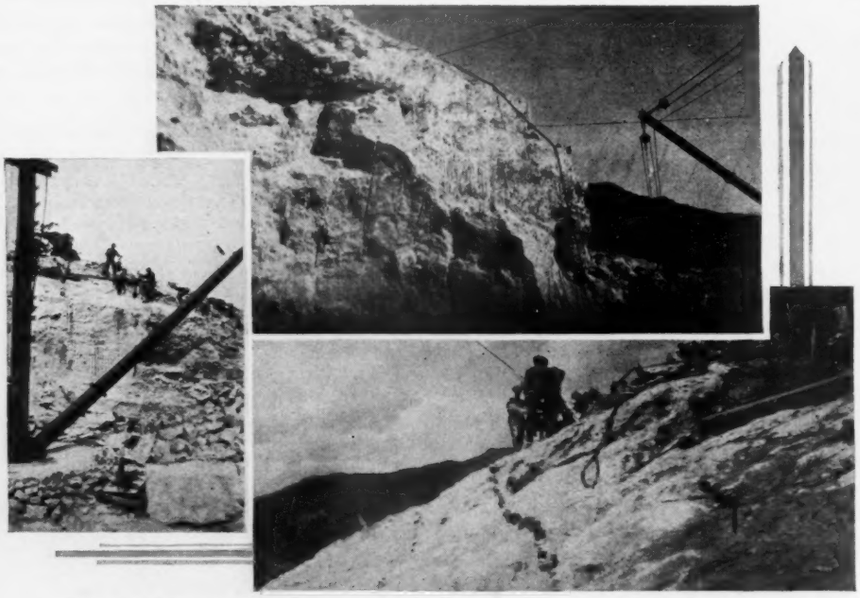
The Colorado travertine deposit is owned and worked by the Natural Resources Exploration Company and is located about six miles east of Salida and within a few hundred feet of the main line of the Denver & Rio Grande Western Railroad. The deposit forms one side of a mountain which rises 250 feet from the floor of the valley. This mode of occurrence permits more economical quarrying than is generally possible in getting out building stone. By starting operations near the top, and carrying them progressively downward as the stone is removed, it will be possible to quarry the entire deposit down to the valley level without the formation of a pit and the attending necessity of hoisting the stone in handling it. Waste material can be quickly disposed of by merely putting it over the dump, allowing it to go down the rather steep mountain slope. There also is the added advantage that there will never be an accumulation of water that will require pumping operations.

The travertine extends for approximately 1,300 feet along the side of the mountain, and is 200 feet through at the top. While the plane followed by the back of the deposit has not been determined, it is assumed that it is roughly parallel to the face that is exposed on the mountainside. Based on this theory, calculations indicate that the mass available for quarrying before the valley level is reached contains about 64,000,000 cubic feet of stone. No effort has been made to learn whether the deposit persists below the valley level.

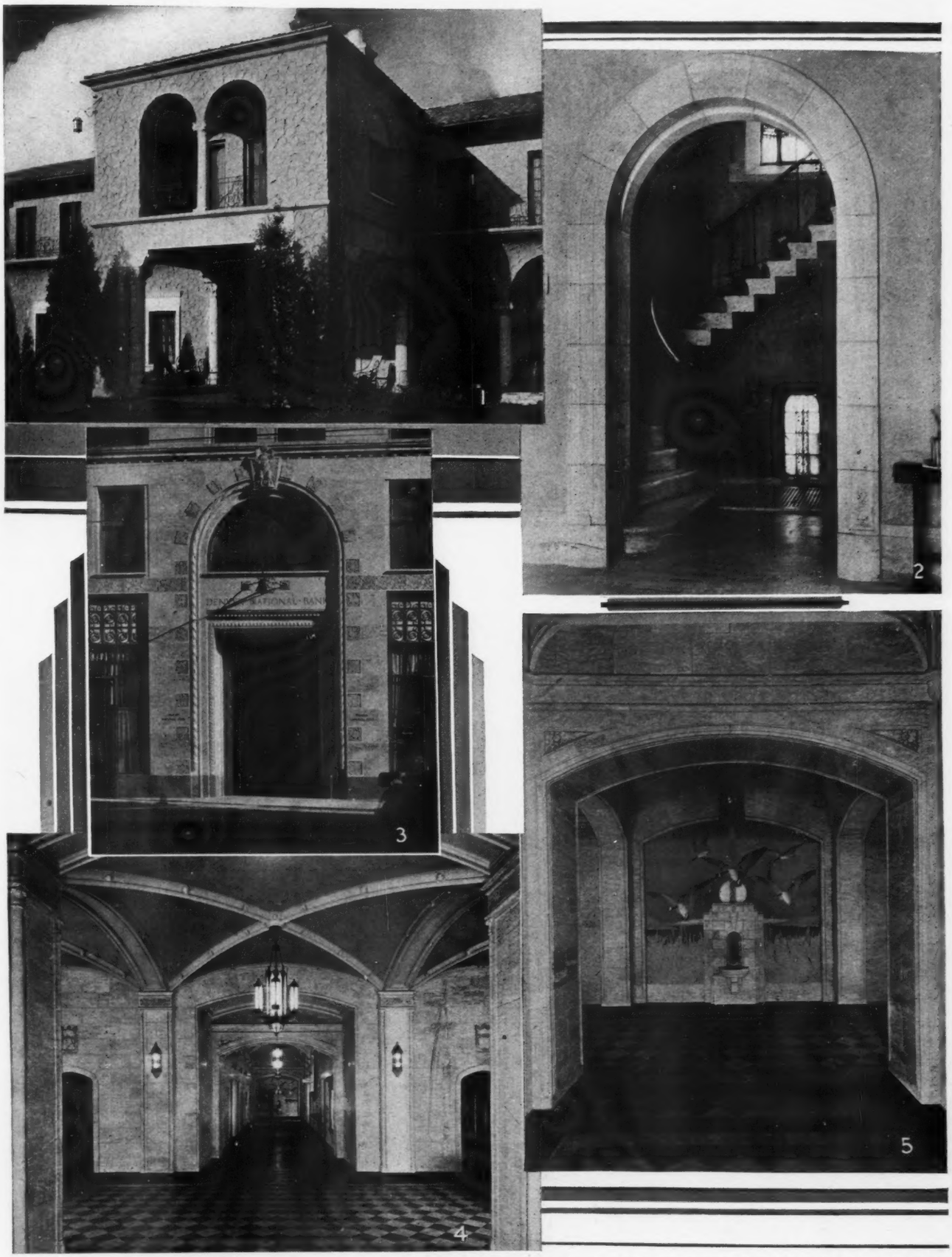
The deposit has been opened by cutting a horizontal bench at the top of the mountain. Blocks are taken out by the following method: A channel is drilled on a line 16 feet back from and parallel to the face. This is done with an X-72 drifter drill mounted on a 12-foot quarry bar. Excellent results are obtained with this equipment, it being possible to drill 3½ feet per minute, or as fast as the operator can rotate the feed screw on the drill. In channeling, the holes are placed practically touching each other. Farther spacing of the holes and broaching has been tried, but has not yet been successful because the nature of the rock is such as to cause frequent breakage of the steel used in broaching.

The back channel of down-holes is carried along for a distance of 200 to 300 feet, depending upon the nature of the ground. At intervals, averaging 12 feet, cross channels are cut from the face to the back channel. The blocks thus outlined are undercut with R-12 "Jackhamers" 5 feet down from and parallel to the top plane. These holes are spaced from 12 to 18 inches apart and extend to within 3 or 4 inches of the back channel.

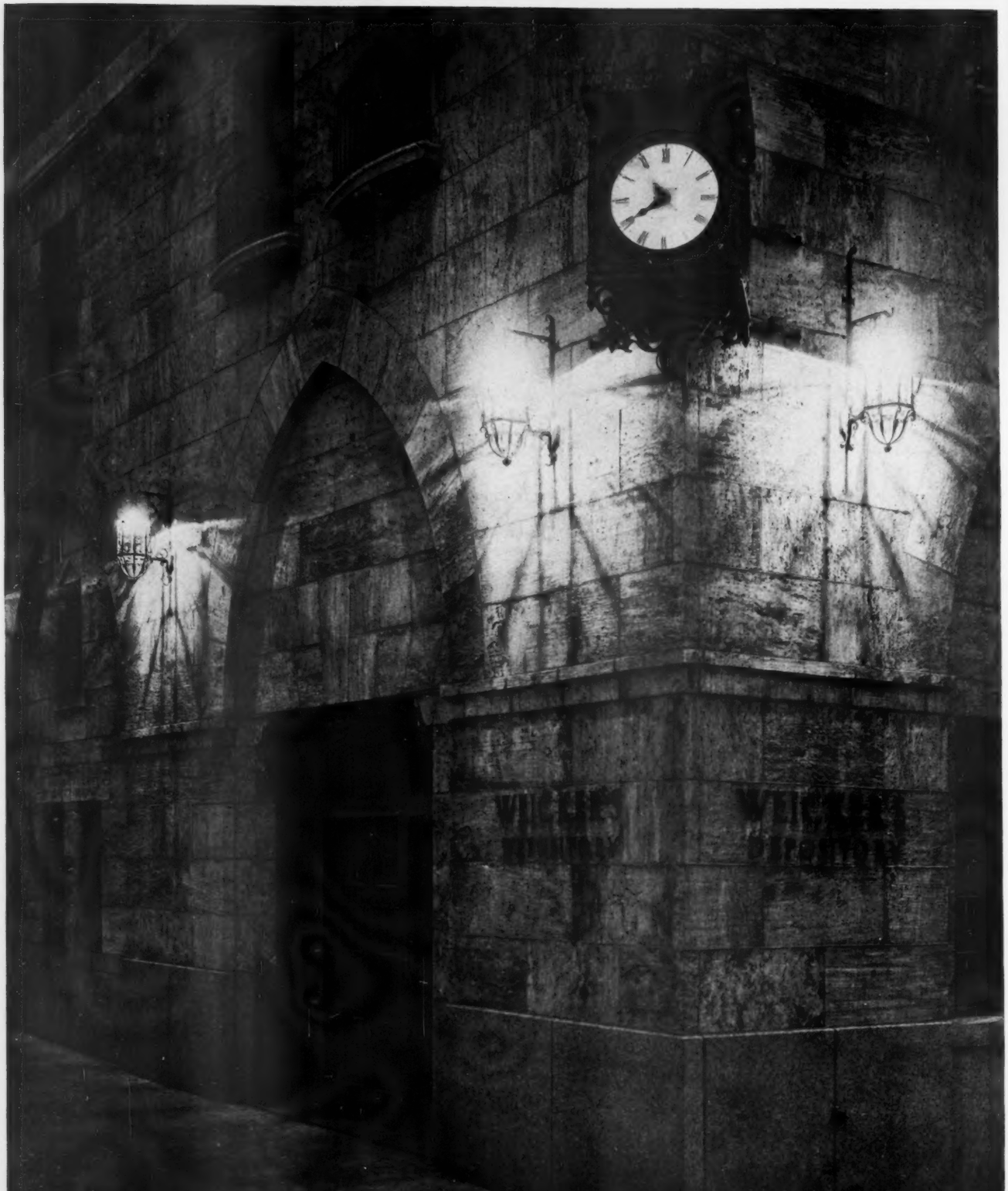
Each of the "Jackhamer" holes is loaded with half a cap box of black powder, and all are fired simultaneously by an electric detonator. This detaches the blocks, but does not shatter the stone or injure it in any way —a fact which is explained by the nature of travertine. It has no cleavage faces, and therefore does not possess the tendency to fracture that is characteristic of most forms of stone. Partly because of this feature, also, the deposit as a whole is remarkably compact. It is broken by only three or four fracture planes. These run through the mass almost



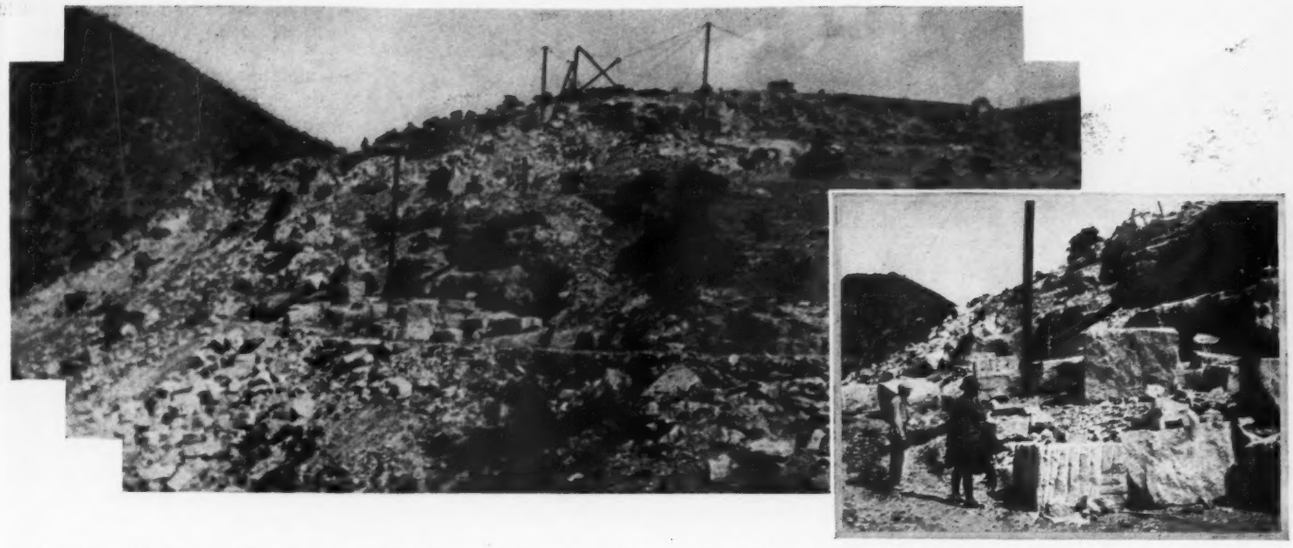
Group of views of the travertine deposit in Colorado. The left-hand and lower right-hand illustrations show workmen cutting channels with X-72 drifter drills.



Fisher & Fisher, Denver architects, have utilized Colorado travertine with pleasing effect in a number of structures in that city. 1 and 2—Exterior and interior uses of the stone in residences. 3—Entrance to a bank. 4 and 5—Travertine has been lavishly employed in Denver's new telephone building.



Night view of a corner of one of Denver's business buildings. The lower two stories of this structure are faced with travertine.



Left—General view of the quarry of the Natural Resources Exploration Company. Right—Some blocks of travertine secured in developing the quarry face.

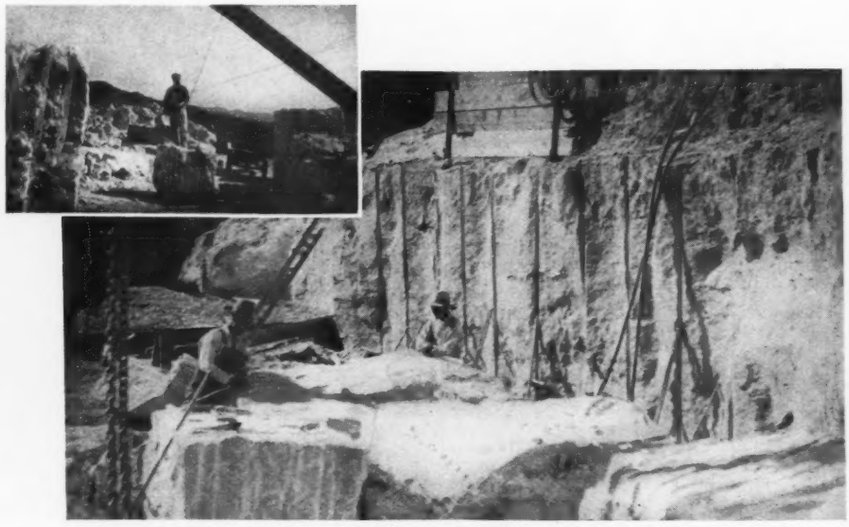
perpendicularly to the exposed face. When one of these fractures is encountered, advantage is taken of its presence and it is made to serve in lieu of one of the cross channels.

A practical illustration of the unbroken character of the deposit was furnished recently when a block of stone 30 feet long and 8x6½ feet on the sides was detached intact from the main mass. This block contained 1,560 cubic feet, and weighed approximately 100 tons. It was quarried as a demonstration to architects that they might safely specify the stone for pillars and for other purposes requiring large-size pieces without fractures.

The blocks as formed by the procedure just described are approximately 16x12x5 feet in dimensions. These are broken up by the plug-and-feather method into smaller blocks for shipment. To effect this, "Jackhamer" holes are drilled in line about 6 inches apart. Whereas in working granite it is necessary to carry such holes to a depth of only a few inches, the absence in the travertine of cleavage faces, as previously mentioned, requires that the holes pass about three-quarters of the way through the block. When the holes have been drilled, each is fitted with a plug or wedge of steel, which is inserted between thin strips or feathers of steel. By tapping each of the plugs, in turn, sufficient side thrust is exerted along the plane defined by the line of holes to split the block as desired. The plugs are driven with Ingersoll-Rand paving breakers, one BC-35 and one CC-35 being employed.

The smaller blocks, as quarried, are roughly 4x5x6 feet in dimensions, and each contains from 100 to 120 cubic feet of rock. Before shipment is made, the high areas between drill-steel holes and other irregularities are removed. This work is done with paving breakers, fitted with moil-point steels. Another tool used for this work is a 56-H clay digger, which has proved very effective. The clay digger is also employed in the experiments that are being carried on from time to time in an effort to develop a suitable method of broaching. Compressed air for all the operations is furnished by an Ingersoll-Rand 10x8-inch portable compressor which is housed in a shed on the property.

Each of the blocks prepared for shipment weighs about 8½ tons. They are loaded by derrick on to a trailer, and drawn to the railroad by a Fordson tractor. Because of the more than 200 feet of descent that must be made from the mountain top, the present haul is about three-quarters of a mile. As the operations proceed farther down the slope of the mountain this distance will be decreased.



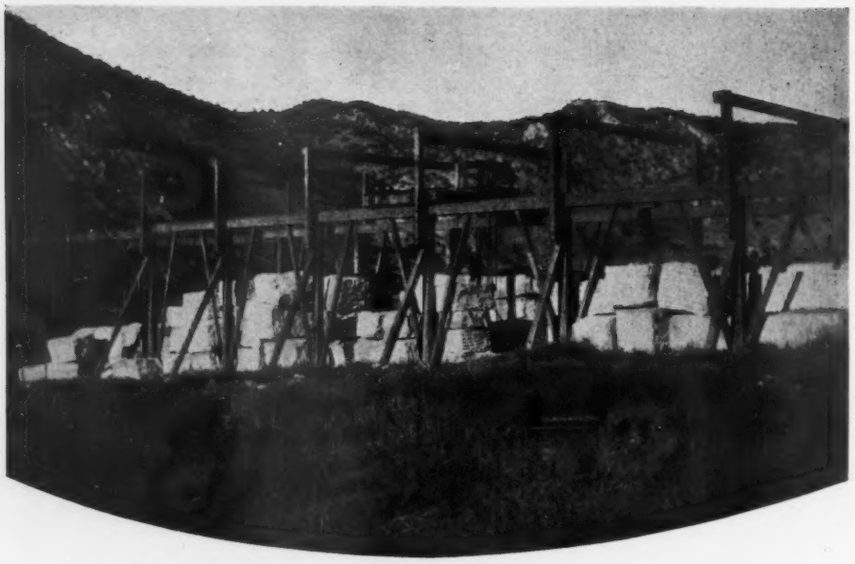
Portions of a monolithic block of travertine that weighed 100 tons as quarried. Insert—Workman drilling "Jackhamer" holes preparatory to breaking a block of stone by the plug-and-feather method.

No provision has yet been made on the property for working the stone into final shapes for building purposes. The entire product is marketed through one of the large marble companies, and it is milled at the nearest point of use that offers adequate facilities. For interiors, where a thin veneer suffices, the stone is generally milled into slabs ⅞ inch thick. For exterior application a heavier facing is desired, and slabs up to 4 inches thick are commonly employed.

The stone is becoming well known and popular in Denver, and almost every business building erected there during the past few years contains some of it. It also is well suited for fireplaces, doorways, and the like, as the rich appearance of the marble adds a much desired decorative touch to the interiors of residences.

The high durability of this Colorado travertine has been proved in at least one instance in Denver. Flagging made from it forms the entrance to and a portion of the sidewalk in front of one of the retail stores on 16th Street, which has the heaviest pedestrian traffic in the city. After being seven years in place the surface shows no traces of wear and retains its original appearance in every way.

Chemical analyses of Colorado travertine show the following principal components: Calcium carbonate, 93.809 per cent; silica, 3.002 per cent; magnesium carbonate, 1.9 per cent; and iron and aluminum, .86 per cent. Representative samples show a compressive strength of from 11,932 to 14,084 pounds to the square inch. The stone weighs 135 pounds per cubic



Loading crane and a part of the stock of uncut stone at the quarry.

foot as compared to 160-170 for granite, 164-175 for marble, and 150 for pressed brick.

The personnel of the Natural Resources Exploration Company consists of the following New York and Chicago men: John H. Taft, president; Richard W. Forrester, vice-president; A. S. Ailes, secretary; John A. Taft, treasurer; and Justin H. Haynes, managing director with offices in Denver.

SURFACING CONCRETE WITH MOUNTED "JACKHAMERS"

ROADBUILDERS generally have reason to be familiar with the portable pneumatic concrete surfacer because they know that wherever work of this sort has to be done that machine will do it with dispatch. However, its use is not necessarily confined only to roadbuilding and maintenance, as the following instance makes plain.

In adding several stories to the Sears-Roebuck Building in Boston, Mass., the roof of the structure, being flat, was left to serve as a floor. It was of concrete, covered with tar and gravel. After this coat had been removed by hand labor it was found that there still remained on the concrete a skin or film of hard pitch. This had to be got rid of in order to assure a firm bond between the concrete and the granolithic top coat that it was to receive.

Hand-picking was tried, but to no purpose. The men succeeded only in puncturing the skin and in putting a lot of holes, ½ inch deep and ½ inch in diameter, in the concrete. Then a "Jackhamer" surfacer was tried; and so well did this machine perform that three of them were promptly set to work. The rotating motion imparted to the drill steel caused the bit to tear off the film of hard pitch; to push it aside; and then to give the concrete the necessary rough or bonding surface.

A standard ⅞-inch, hexagon, hollow drill-steel starter with a 2-inch gage, 4-point bit was used; and so as to blow dust and particles of concrete away from the immediate zone of operations a hose was run from the "Jackhamer" exhaust down to the bit. As a matter of fact, the spread of dust, which at first threatened to be troublesome on this inside job, was prevented by spraying the roof with water.

And now we come to facts and figures, which are generally of most interest to the contractor. Each unit covered on an average 1,000 square feet of surface per working day, removing the pitch and a layer of concrete ¼ inch thick. The cost of labor per hour amounted to $4.175, or slightly in excess of $0.01 per square foot of roof surfaced. The charges were divided as follows: four men—three at the surfacers and one sweeper—at $0.70 each, and the compressor operator at $1.375 per hour. The latter attended to the two machines, an 8x6-inch and a 5½x5, which supplied the compressed air for the "Jackhamers". The work was done by the Equipment Company of Boston.

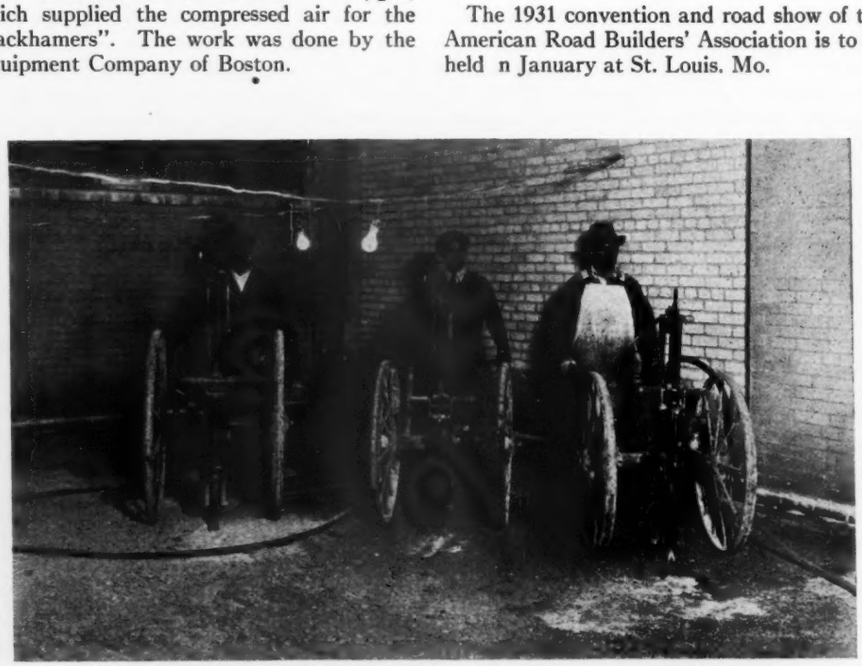
METALLURGISTS HELPED TO CARRY "ENTERPRISE" TO VICTORY

THE metallurgist is carrying off his share of the honors that were won by the American cup defender *Enterprise* during the international yachting classic that was held not long ago in the waters off Newport. Superb seamanship and excellent design alone were not responsible for the decisive victory achieved by that craft over Sir Thomas Lipton's challenger, *Shamrock V*. It is conceded that the metal mast of the *Enterprise*, provided at great cost, and its rigging, which is as perfect as the skill of the metallurgist could make it, had much to do in enabling the *Enterprise* to maintain her lead over the wooden-masted *Shamrock V*.

In racing yachts, with their enormous spreads of canvas, it is essential that the masts and the rigging, designed to carry the sails and to hold them taut, be strong but light—light for speed. And yet, strength must not be sacrificed for lightness—even though speed is of first consideration—because a broken part may make all the different between victory and defeat. These two qualities are not always easy to combine, but in the case of the *Enterprise* that was done.

The mast of the *Enterprise* is of duralumin, an aluminum alloy of light weight and high tensile strength, while the mast slides, long head slides, shackles, and the numerous other castings required for sail-rigging were made of non-corrosive, chromium-bearing alloy steel. This metal is strong without being excessively heavy and is, at the same time, notably resistant to the erosive action of salt water. These small castings were poured by the Lebanon Steel Foundry, in Lebanon, Pa.; and with what success every man, woman, and child in the United States probably knows.

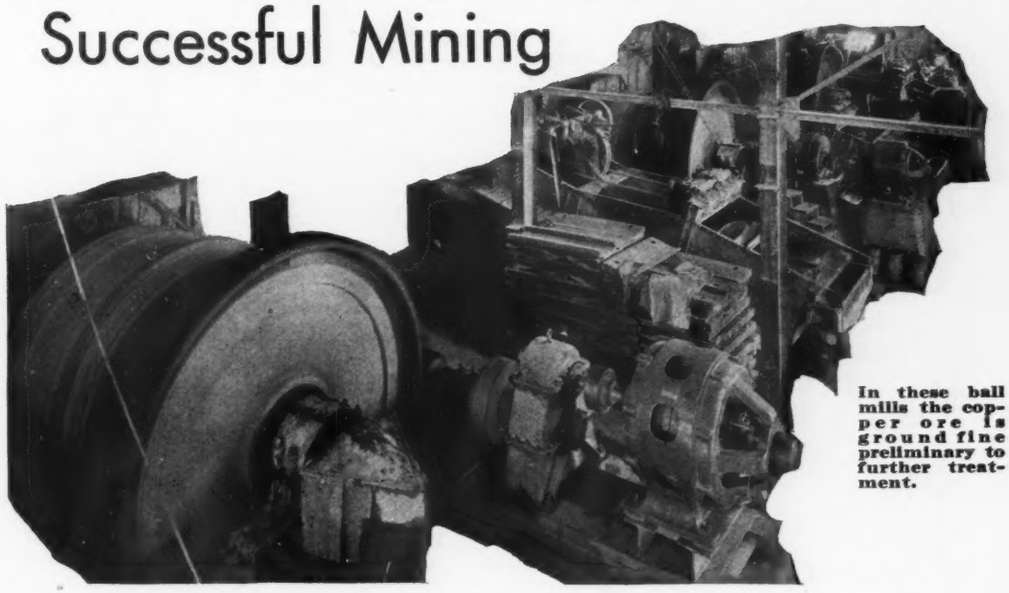
The 1931 convention and road show of the American Road Builders' Association is to be held n January at St. Louis. Mo.



Concrete surfacers on a roof and not on a road job. After other means had failed, these air-driven machines succeeded, in one operation, in removing a film of pitch and in roughing the underlying concrete.

Compressed Air an Essential Aid to Successful Mining

Account of the Large-Scale Operations of the Walker Copper Mine in California



In these ball mills the copper ore is ground fine preliminary to further treatment.

By J. H. COOPER

THIS airminded twentieth century with its fast-increasing knowledge of aviation, has, within the past decade, so rapidly changed the airplane into a commonplace business convenience that the hum of airplane motors now attracts less attention in many parts of the world than does the almost forgotten sound of horses' hoofs on city pavements. When the thrills which all novice air passengers experience during their first flights through the upper atmosphere shall have become lost, then do you know where they could find a similar experience, one which can be repeated time and time again without palling? They would undoubtedly find it in making a trip over a certain aerial tramway which daily, continuously, year in and year out, carries copper concentrates from a mine to a railroad, and which for several months throughout each year is the only means of transportation for supplies and passengers between the outside world and California's largest copper mine.

In the heart of the Sierra Nevada Mountains, not far from the famous mother-lode region of the "Golden Days of '49", lies Plumas County, a beautiful part of the tall-timbered watershed of the Pacific Coast. Although this section is well known to sportsmen and to summer campers, still few of these visitors pause at Spring Garden—a small station on the Western Pacific Railroad and the western terminus of the aforementioned 9-mile tramway—to watch the incoming buckets discharge their concentrates or to wonder at the meaning of it all and of the life and activity at the other end of the line beyond the high mountain peaks in the distance. A ride over this unique airway under favorable weather conditions not only gives a decided thrill to anyone suffering from *ennui* but it offers a panoramic view of mountains, canyons, rivers, and timbered slopes that is a scenic delight long to be remembered.

Of course this 9-mile tramway was not built to provide enjoyment for jaded souls. It arose from economic necessity, for it connects points 57 miles apart via mountain roads that are quite impassable for several months of each year on account of heavy snowfalls. Over it are transported daily from the Walker Mine to the railroad station at Spring Garden more than 100 tons of copper concentrates for transshipment to the converters of the International Smelting Company, at Tooele, Utah, where they are turned into converter copper cakes. Over it also are carried to the mine all light equipment, mill and mine supplies, groceries, and such other provisions as may be required by the 800 persons constituting the population of that thriving mining camp. During the long winter months, when the adjacent roads are blocked with snow, the air line offers the only practical means of getting to and from the mine.

Leaving the concentrate storage bins at the mill at an elevation of 6,200 feet, the tramway descends a few hundred feet, crosses a small valley and the mill tailing pond, and then rises abruptly to pass over a barrier more than 7,000 feet high, thence traveling downward some 3,000 feet to the terminal at Spring Garden. From its highest points of vantage it is possible to view in the distance Mount Lassen, The Sierra Buttes, Mount Ingalls, and many other familiar peaks of the Sierra Nevadas, several of them everlastingly snow covered. At times riding low between avenues of pines, at others soaring high above the tops of the tallest timbers and crossing deep ravines lying in its path, the aerial tramway—swinging on strong cables with spans, between towers, exceeding more than 2,500 feet—affords a trip of one and three-quarter hours duration through a mountainous region that can scarcely be surpassed for grandeur.

The Walker Mine is probably the most important producer in California, providing employment for more men and having perhaps a greater annual output than any other individual lode mine in the state. Despite these facts, and that it has, apparently, years of life ahead of it, the property is but little known to the mining fraternity and to the public at large within the state. This may be, in part, because the mine was originally opened up by Salt Lake City investors, incorporated under the name of the Walker Mining Company. This company is now controlled by the International Smelting Company, of Salt Lake City, a subsidiary of the Anaconda Copper Mining Company. The directing heads of the Walker Mining Company are trained and seasoned production men who have built up this highly successful enterprise to its present splendid proportions.

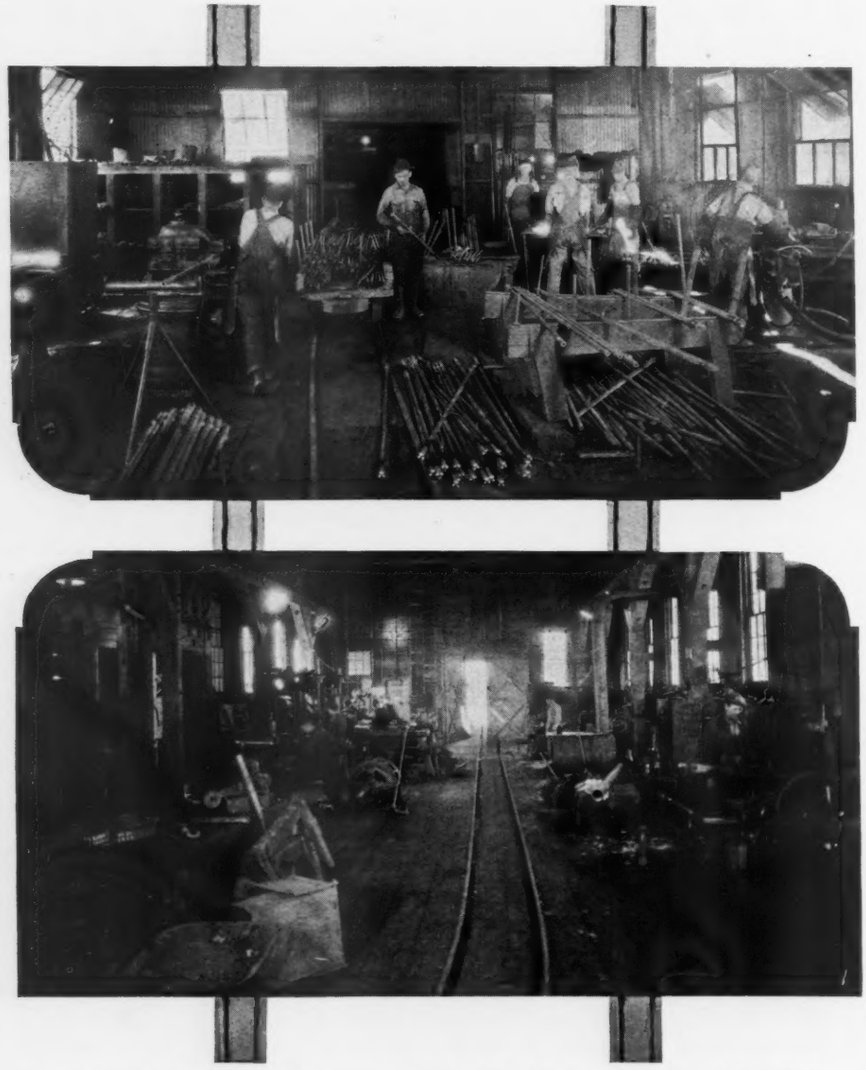
About the year 1900, the Walkers Brothers located the mine and started development work shortly thereafter. While the extensive surface showings on the outcroppings indicated the presence beneath of large amounts of possible commercial copper ore, the values obtained from these outcroppings were decidedly low and somewhat discouraging. However, on the strength of the showings, a shaft was sunk at a point some 800 feet higher in elevation than the present camp site. When it had reached a depth of only 35 feet, the workers encountered high-grade copper ore carrying excellent gold values together with an appreciable quantity of silver. From the sinking of this first shaft, the ultimate success of the undertaking and the future productiveness of the property were assured. Then, following an extensive campaign of prospecting with diamond drills and the installation of modern mining and milling equipment, came a period of further development work to thoroughly prove the mine.

To-day an up-to-date electrically driven flotation mill with a daily capacity of 1,600 tons grinds away steadily. Within the mine

production and exploratory work are proceeding continually, hand in hand, making available the reserve ore and an ever-increasing tonnage of broken ore far exceeding the daily demands of this active mill. The use of electricity is not confined to the mill. Wherever practicable, all surface and mine equipment is electrically operated. Otherwise, compressed air, supplied by motor-driven units, is the motive power. Camp, mill, and mine are electrically lighted—the current being delivered over high-tension lines by the Great Western Power Company. A modern electric sawmill, which cuts some 2,000,000 feet of lumber annually from timber resources immediately adjoining the property, provides the material in steady demand for mine timbering and for structural purposes. In the homes and associate buildings electricity is in general use for lighting, cooking, washing, ironing, etc., while electric ovens, ranges, and refrigerators in the cook house and dining hall at the camp take care of the provisions for some 350 men.

Some idea of the large scale on which the Walker Mine is being worked can perhaps be grasped by a survey of the accompanying bird's-eye view of the property with its timber-framing sheds, blacksmith shop, compressor house, machine shops, mill buildings, steam-heating plant, dormitories, staff house, store, hospital, steam laundry, warehouse, office, community hall, and schoolhouse providing for the needs of more than 60 children of grammar-school age and where general instruction and lessons in American-ization are given at night for the benefit of the adult population. And for the accommodation of the married employees and their families there are 70 modern 2-, 3-, 4-, and 6-room cottages.

Everything has been done by the management not only to safeguard the health of the people in this isolated mountain region but also to provide for their comfort and amusement. Pure mountain water is piped from springs and fed by gravity to the living quarters. A gravity sewerage system serves all buildings and dwellings, while garbage is collected and disposed of daily. The hospital, in charge of a resident doctor and two trained nurses, is well equipped with all the latest instruments and apparatus, including an X-ray machine and oxygen tanks with breathing helmets for the treatment of pneumonia patients. The steam laundry was erected for the benefit of the women of the community and relieves them of the drudgery of washing. And, finally, there is the community house where entertainment aplenty is to be had in the form of moving pictures, dances, and other social gatherings.

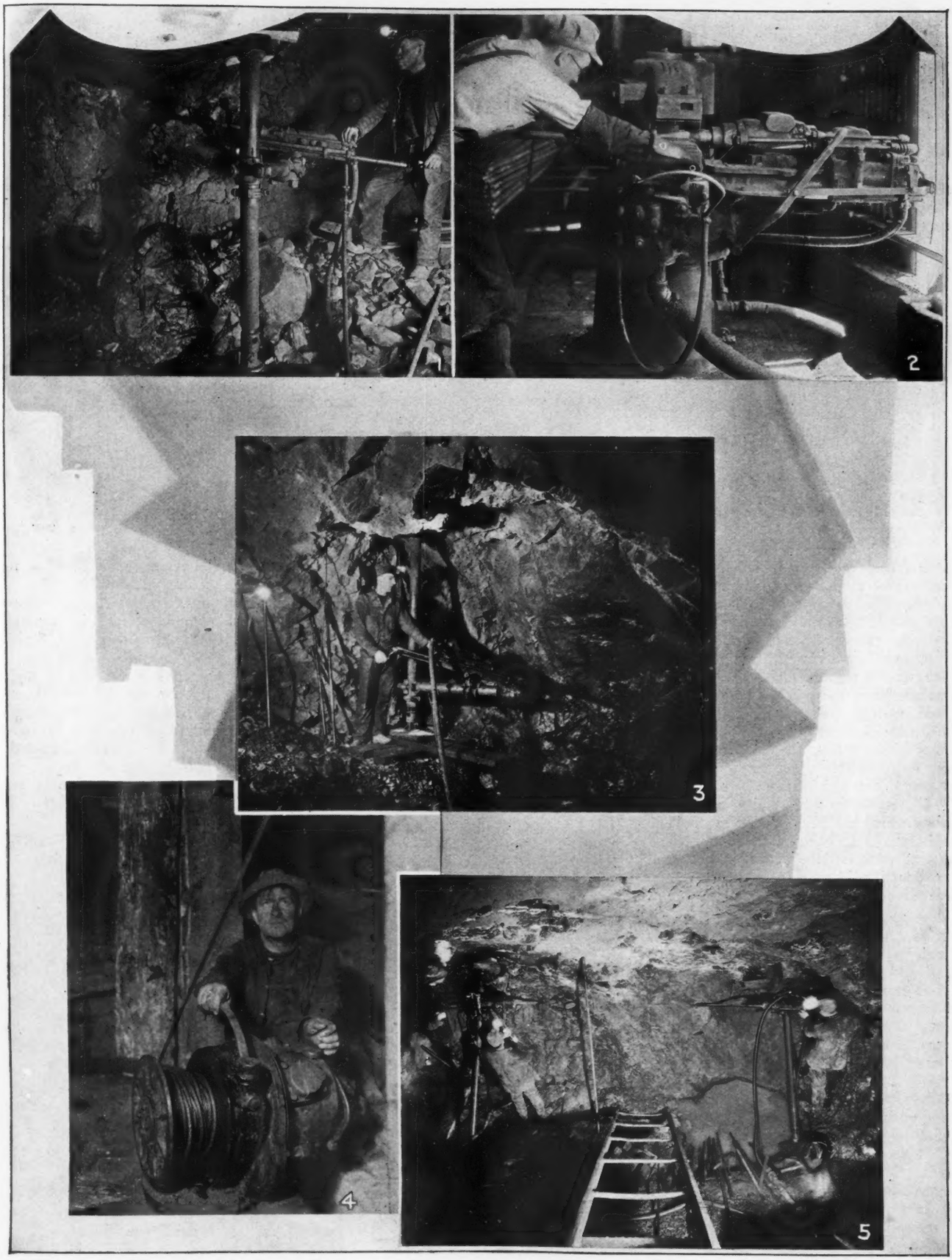


Top—The blacksmith shop at the Walker Mine is a busy place and is called upon to recondition between 800 and 1,000 drill steels daily. This work is done by means of two Ingersoll-Rand sharpeners and two oil furnaces. Bottom—The roomy machine shop on the property is well equipped to take care of the needs of this isolated mining camp.

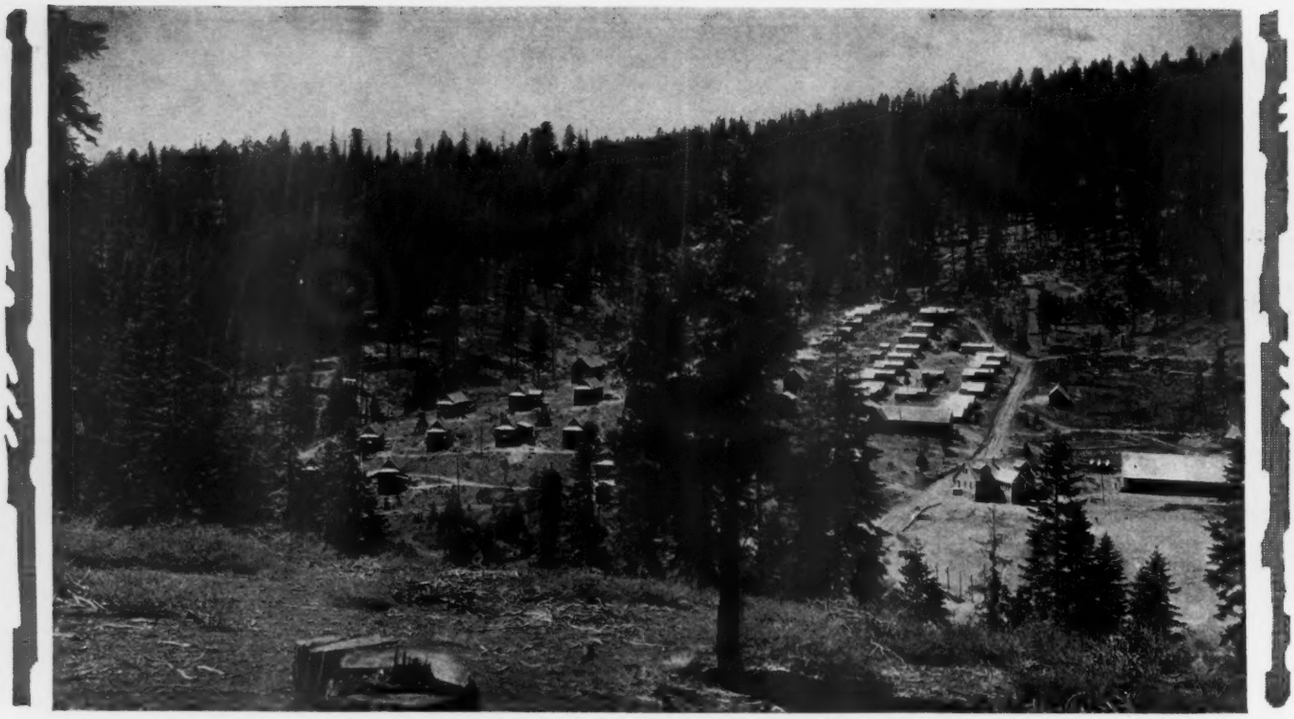
The main haulage tunnel or 7th level starts from the mine portal at an elevation of 6,200 feet and is on a level with the top of the mill supply bins. It is driven as a crosscut through granodiorite for approximately 3,000 feet, at that point striking the main vein along which it continues until it is more than two miles in from the portal. In its course it cuts through five separate ore bodies—the South, the Central, the North, 712, and the Piute, thus giving a vertical depth on the vein of from 700 to 1,200 feet, depending on the contours of the outcroppings overhead. As the dip of the vein varies from 45° to 60° above this tunnel, the slope distances along the vein available for stoping are considerably more than the vertical distances would seem to indicate. All ore from above the 7th level runs by gravity through the stopes to loading chutes along the haulage tunnel, whence it is dumped into electrically operated trains and hauled to the mill bins.

Below the main haulage tunnel the vein has been developed for a vertical depth of 500 feet in the South and the Central ore bodies through two inclined winzes and the opening up of the 8th, 9th, and 10th levels. The present lowest-level workings show excellent values and widths of vein comparable with those encountered overhead. There is no appreciable change in the character of the ore or its occurrence, giving every indication that the vein and values will continue to much greater depths. Only a small percentage of the ore produced to date has come from below the main haulage tunnel, but several stopes have been opened up on the 8th, 9th, and 10th levels in order to prove the ore bodies. In the Piute ore body sinking has been underway for some time. A 3-compartment timbered winze is now below the 9th level and, at the time of writing, a crosscut at this depth penetrated the vein—width as yet unknown—in excellent values. On the 8th level a similar crosscut passed through about 25 feet of ore without encountering the hanging wall.

Haulage on the main level is done by electric motors of the Baldwin-Westinghouse trolley type—direct current being supplied by motor-generator sets at the portal and in the Piute compressor room. These motors handle trains of eleven cars, each of 3 tons capacity, with V-shaped bottoms and side-opening doors. These cars are fitted with Timken roller bearings and are manufactured in the company's own machine shop. The 10th level is similarly equipped with motor haulage.



1—Square-set stoping in Ore Body 712 with an N-75 drill mounted on a column. 2—Close-up of one of the two No. 50 pneumatic sharpeners that take care of all the mine's drill-steel requirements. 3—An N-72 drill at work in a shrinkage stope between the 6th and 7th levels. 4—Air-operated "Utility" hoists, such as this one, are used extensively throughout the mine for handling drill steels, timber, and other supplies needed underground. 5—Looking down the Piute shaft on two column-mounted N-75 drifters drilling on the 9th level at a point approximately 400 feet below the main haulage tunnel or 7th level.



Bird's-eye view of the Walker Mining Company camp, high up in the Sierra Nevada

In general, shrinkage stoping is the method used, but some square-set stopes are also carried where the hanging wall is bad and where pillars of high-grade ore are removed in old stopes. Fortunately, the ground for the most part stands well, requiring no timbering; and in the few places where such has been necessary the ore has been of the high-grade variety that warrants the increased cost thus incurred. Regarding widths and extent of ore bodies, the stoping widths run from 40 to 70 feet while the ore bodies have a lateral extent of from 800 to 1,500 feet. The latest ore to be developed is in the Piute body which has been opened up for a lateral distance of 1,320 feet. Practically all development work is done in ore, excepting when crosscutting for a vein, so that very little waste is produced.

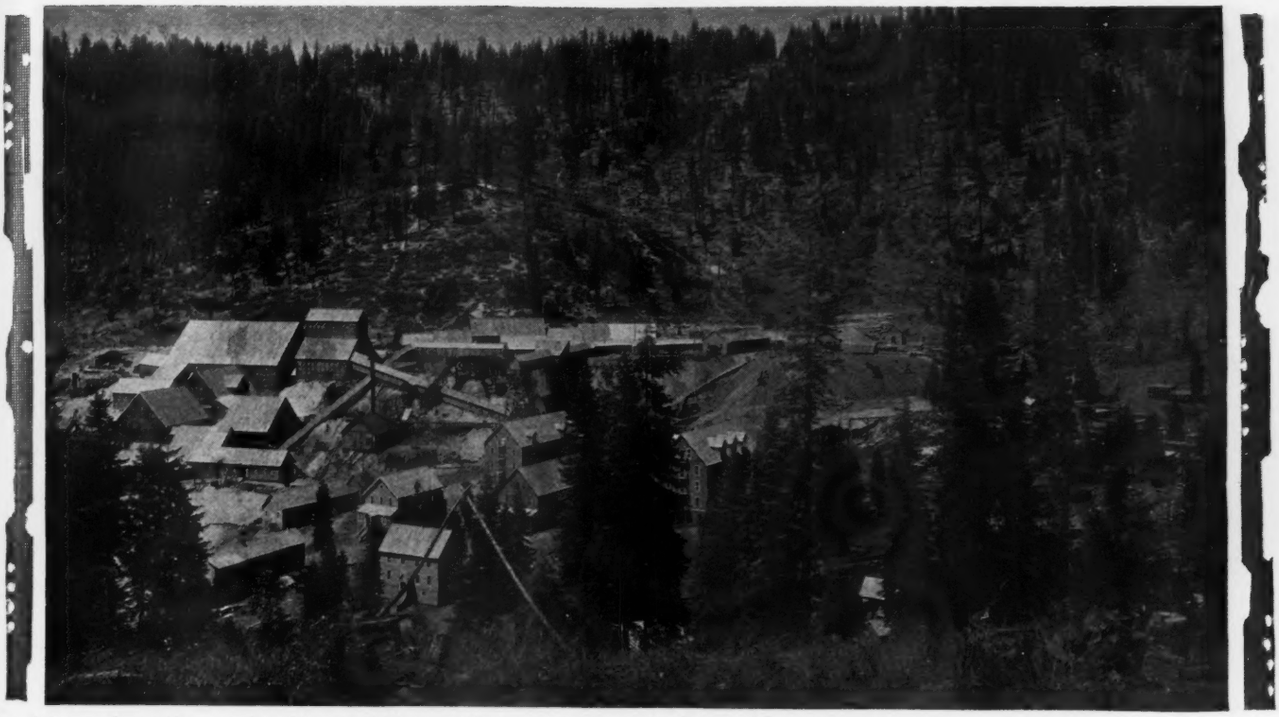
All development and stoping operations are carried on with the aid of air-driven machine drills of the wet type to prevent the spread of rock dust. Numerous Ingersoll-Rand N-75 and R-72 drifters are at work at the headings and in the stopes. Stopehamers and lighter types of drills could not be used there because the rock throughout the mine is unusually hard and close-grained. However, I-R "Jackhamers", including R-39, BCR-430, RA-12, and DCR-23 machines, are giving good service on the grizzly levels in plugging large boulders. A group of R-51 and BC-21 stopehamers completes the drill equipment. The latter do light plugging in drifts and elsewhere, and drill boulders that are too large to pass through the finger raises leading from the stopes to the grizzlies.

For lowering and hoisting steel, timber, and other supplies into and out of the stopes portable air hoists are in service. Of those in use, perhaps the EU Type, shown in one of the accompanying illustrations, has been most satisfactory. Altogether there are eighteen hoists in the stopes, as well as one Ingersoll-Rand double-drum portable slusher hoist that operates a drag-line scraper for cleaning down the stopes where the vein is too flat for the ore to run by gravity.

Anywhere from 800 to 1,000 drill steels are resharpened, tempered, and, if necessary, reshanked and straightened during each shift. In addition, about a ton of new steel is cut up, shanked, and formed each week for replacement purposes. For this work the blacksmith shop is equipped with two No. 50 drill-steel sharpeners fitted with LP punches. The tempering is done by means of two No. 25 oil-fired furnaces.

A constant, dependable, and low-priced supply of compressed air is required to operate all the aforementioned air-driven machines, as well as many other pneumatic devices of one kind or another in the mill, the timber shed, the saw mill, and the blacksmith and machine shops. To furnish this air a compressor plant has been located near the mine portal. In this are installed one Type PRE, 2-stage, direct-connected, motor-driven unit, rating 1,750 cubic feet of free air per minute, and three Imperial XB-2,

The fine mill buildings of the Walker Mining Company through which 1,600 tons of ore pass daily. It is at this point that the aerial tramway, to be seen at the left, starts on its 9-mile journey to the railway station at Spring Garden.

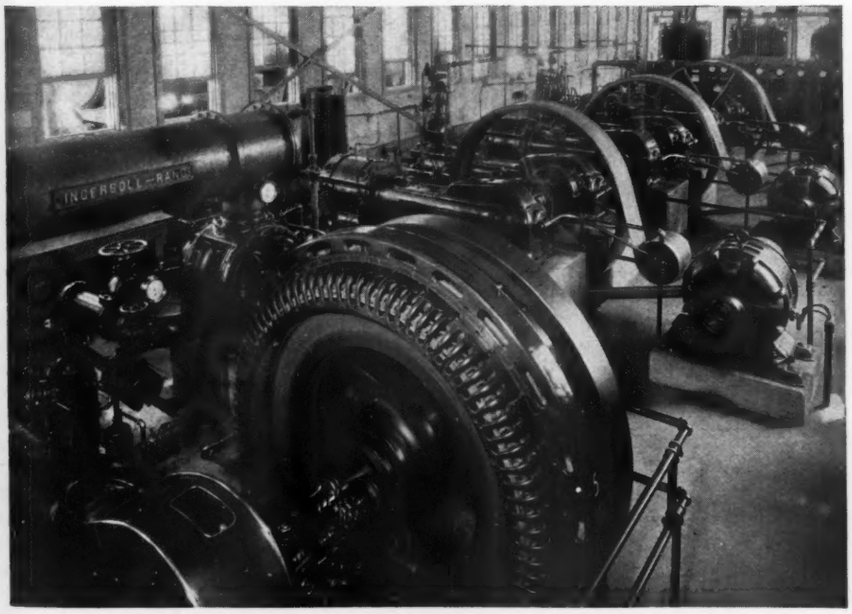


Mountains, where thousands of tons of high-grade copper ore are produced yearly.

two-stage machines each belt driven from a 100-hp. motor and having a rating of 677 cubic feet of free air per minute. A duplicate of the Type PRE is installed at the collar of the Piute shaft, something like 2½ miles away, which connects with the main haulage level. A 6-inch air line leads from the compressor room at the portal through the haulage tunnel and up to the Piute compressor, thus linking up the two units. From this main air line extend branch lines to all the working places both above and below the main haulage level. A pressure of 100 pounds per square inch is maintained at the compressors. The part which compressed air has played and is continuing to play in the development and production of the Walker Mine is an important one—in fact, compressed air has been essential to the economic success which has been achieved.

Some statistics regarding operating results should be of interest. During 1929 there were milled 457,637 tons of ore producing 32,375 tons of concentrates. Of these, 32,266 tons were delivered to the smelter and yielded 15,034,383 pounds of copper, 294,757.01 ounces of silver, and 15,767.966 ounces of gold. The total returns from the sale of ore and concentrates amounted to $2,551,109.79, showing a net operating profit of $1,015,758.84.

It is the wise policy of the management to maintain ample ore reserves; and ore breakage in the stopes consistently runs well ahead of withdrawals. Development work is years in advance of requirements and is being rapidly continued, the ore reserves being appreciably augmented annually. At present there are estimated reserves in the neighborhood of 10,000,000 tons, giving the property very definite assurances of a long life ahead. In all, from 450 to 500 men are regularly employed at the Walker Mine, and during the summer months, when logging and sawmill operations are underway, another 20 to 25 are in service there. The future of the Walker Mining Company, which comes under the Mines Operating Department of the International Smelting Company, is in able hands.



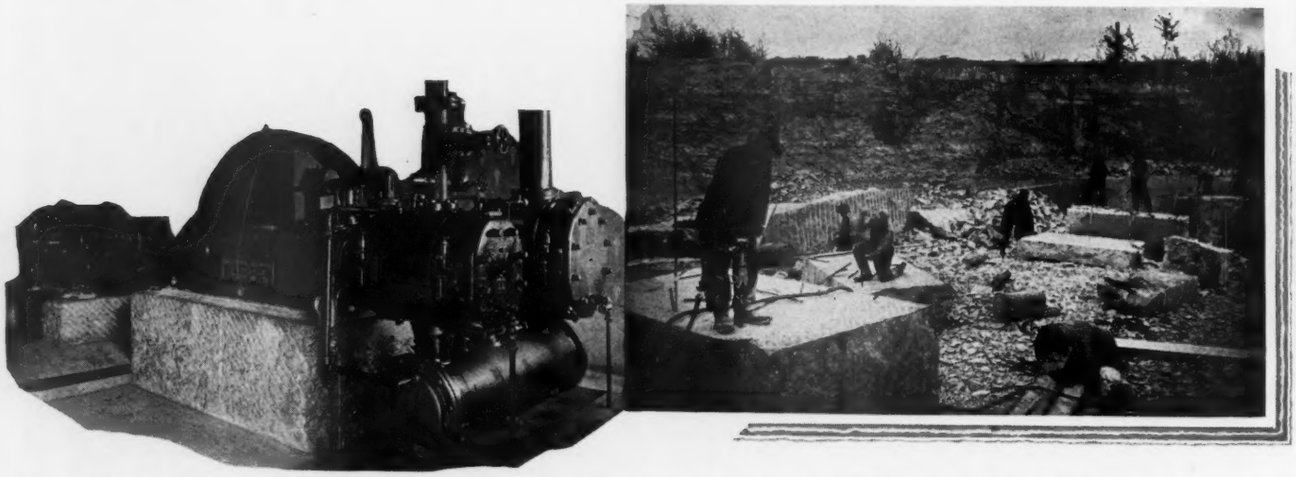
Main compressor plant at the Walker Mine which supplies 3,781 cubic feet of free air per minute. The installation consists of one PRE machine, in the foreground, and three XB-2 units. Another PRE compressor is located at the collar of the Piute shaft.

IMPORTANT FIND OF SILICA SAND

LARGE deposits of sand suitable for the making of glass have within recent years been found in the State of Nevada. These discoveries are of no small importance especially to our Pacific Coast manufacturers who have, in the past, obtained most of this material from Belgium because of a lack of domestic sources of supply within reasonable hauling distance. In Clark County there is a very extensive bed which is now producing. The sand contains 98.90 per cent of silica, 0.05 per cent of iron oxide, 0.65 per cent of alumina, and 0.05 per cent of lime. It is suitable for the making of glass of many kinds, and thousands of tons of it have already been used in California factories. What is said to be another high-grade deposit has lately been located in Washoe County.

Colorful Limestone from French Quarries

By N. S. OLKHINE



Left—Air at the new quarry is supplied by an XCB-2 Ingersoll-Rand compressor. Right—Section of an older limestone quarry which is still actively worked by the Societe Anonyme des Carrieres d'Hauteville.

PRACTICALLY inexhaustible limestone beds, lying at an altitude of 3,280 feet at Haut Bugey in the Department of Ain, are being actively exploited by La Société Anonyme des Carriéres d'Hauteville. The rock quarried by this company is classed as a coral limestone. It is fine grained and dense in structure, and of a uniform light-yellow color—taking a notably high polish. To be specific, the rock contains numerous oölites that have a mother of pearl luster. These, in combination with the calcite crystals that fill the fissures of the mass, greatly enhance the charm and the generally pleasing tone of the stone.

Hauteville limestone is widely known and esteemed because of its structural uniformity, its soundness, and its resistance to the erosive action of the weather. Quarrying operations are carried on without interruption in the wintertime despite the fact that the workings are at a considerable altitude. This is practicable because the stone is capable of withstanding the fracturing action of frost. By reason of this highly desirable characteristic the stone can be used satisfactorily for either the interior or the exterior of buildings.

The following interesting data about Hauteville limestone are found in the well-known scientific dictionary compiled by Poire & Perrier: Its resistance to fracture is 912.77 kilograms per square centimeter (12,982 pounds per square inch); crushing strength, 1,167 kilograms (2,572.75 pounds); and weight per cubic meter, 2,762 kilograms (4,655 pounds per cubic yard). According to an eminent authority of the University of Lyons, who has made a geological map of the Southern Juras: "The Hauteville rock belongs to a widely spread coral-limestone or reef-limestone formation which could have been laid down during any one of many geological eras. The variety in question is composed of fragments probably washed off or detached from coral reefs or ledges by wave action during the Lower Cretaceous period. These fragments either remained angular or became rounded by the grinding action of the sea, which thus produced a sand composed of granules of different sizes. Some pieces of the limestone contain bits of coral, mollusks, and other evidences of organic life associated with ledges, together with a greater or lesser distribution of different varieties of oölites. The coral sand became agglomerated by the calcium carbonate carried by the sea water. Thus was formed from a milky solution or mixture a limestone of rather pronounced primary hardness—the rock afterwards, in many instances, passing through a phase of recrystallization. This process tended to increase the hardness of the limestone.

"In the course of time, the identity of the original fragments or particles of the primary limestone became less discernible, and finally became intimately blended with the whole complex structure of the rock. Subsequently, by reason of the infiltration of water and the process of oxidation, the transformation continued. The penetration of other substances in solution, particularly silica, also altered the composition of the rock—the silica acting directly on the embedded fossils. In this way, the Hauteville rock came into being and changed gradually into the condition in which it is now found.

These two Ingersoll-Rand ER-1 compressors provide air for operating rock drills and for other purposes at the older quarry.

"The Hauteville rock probably originated in the early Cretaceous era and belongs to that stratum which geologists designate as the Valangian. This stratum and the one following it constitute the bed of the Hauteville synclinal valley. The Valangian rock has a marked coralline appearance; and it was, undoubtedly, formed for the most part from fragments of coral reefs."

The Hauteville quarry company employs a total of 70 men in its quarries. In the main, the limestone is got out mechanically—using Ingersoll-Rand air-driven rock drills in the incidental

1—A corner of the new quarry. Men at left are drilling plug holes with "Jackhamers" preparatory to splitting the large block. 2—An X-70 Ingersoll-Rand drill broaching a rectangular block in the quarry floor to form a well in which to mount a tension post for the wire saw. 3—Various stages in getting out blocks of Hauteville limestone. 4—Comprehensive picture of one corner of the new quarry. 5—Two tunnels, passing under an established highway, provide ready means of entering and leaving the new quarry.

drilling and broaching required in removing large blocks of the stone. The rock drills are utilized both for work on the ledge as a whole and in preparing the way for the employment of wire saws, and are mounted generally on quarry bars. The wire saws have proved entirely satisfactory in doing the work assigned them. All drill steels are reconditioned with the aid of a pneumatic sharpener.

The annual output of stone at Hauteville is approximately 1,500 cubic meters—that is, 1,962 cubic yards. The stone is exported principally to North America, South America, Australia, and Japan, where it is utilized both in monumental work as well as in the decorating and in the facing of business and other structures. In Paris, this very pleasing stone has been employed in building the Grand Hotel, the Palais Guynemer, and the Palais des Textiles, while in Nice it has gone into the construction of the well-known Immeuble Madisson, the Palais Imperator, etc., etc.

The blacksmith shop is equipped with an Ingersoll-Rand pneumatic sharpener for conditioning drill steels.

Responding to the present-day demand for color, this excellent limestone is popular because of its mellow tone and distinctive texture. Once more we have in this attitude of the public evidence of how tastes change and materials acquire a vogue which may have been denied them previously.

An untold quantity of radium is declared to be locked up in Stone Mountain, in Georgia, upon the face of which is being sculptured a memorial to the men that fought and died for the Southern Confederacy. Professor James A. Hootman, of the physics department of Emory University, Atlanta, has made an extensive investigation of nine springs which have their source in Stone Mountain. His tests, so he says, show that these waters contain 35,040 curies of radioactivity as compared with the 16,500 curies in the renowned Joachimsthal Spring, in Bohemia, which has its headwaters in a pitchblende mine. This mine has in the past supplied a large amount of the world's radium.

APPROVAL

To The Editor of Compressed Air Magazine:

Sir:—I wish to commend your editorial, *Our Patent System Menaced*, which appeared in the October issue. Although practically all of the Bar and Patent Bar Associations have joined in condemning this ill-advised measure, and a pamphlet prepared by Otto Raymond Barnett, Esq., analyzing the bill and pointing out the serious difficulties which would follow its enactment has been published by the American Patent Bar Association, little interest in the subject has been shown by scientific and engineering journals. I hope that the interest of your Magazine forecasts an awakening of general attention to the threat of the Dill Bill.

One serious menace of the Dill Bill is that it provides a civil penalty for a criminal act and provides that the imposition of the penalty shall be decided in a civil suit. The inconsistency of such procedure is so obvious to attorneys that possibly it has not been explained clearly enough to make it equally clear to the layman.

Our law provides that no one shall be condemned without trial, and it further provides that everyone is presumed to be innocent until he is found guilty. The presumption of innocence means that unless a court is convinced beyond a reasonable doubt of the guilt of the accused, he shall be acquitted. In other words, in a criminal action, the accused is not guilty unless his guilt is proved beyond a reasonable doubt. In a civil action, however, a state of facts may be proved by the preponderance of the credible evidence.

The preponderance of the credible evidence is quite a different matter from proof beyond a reasonable doubt. It is quite possible, and indeed it often occurs in a criminal trial, that the greater weight of the credible evidence indicates that the accused is guilty, but there still exists a reasonable doubt of his guilt, and he is acquitted. Undoubtedly this rule has sometimes resulted in the guilty going unpunished, but it is obvious that a great number of innocent persons would suffer unjustly if another standard were adopted.

By providing that a court of equity shall have the power to decide whether or not a plaintiff is guilty of criminal acts (violations of the Sherman Act and the Clayton Act are criminal), the Dill Bill permits an accused to be found guilty by the preponderance of credible evidence, and to be punished not by the punishment provided in the laws which make his acts criminal but by the loss of property rights.

There is no attempt to make the punishment fit the crime. The gross offender against the law might suffer the loss of a trivial patent, and a slight offender might lose patent rights worth millions of dollars.

Any attempt to graft such innovations upon the body of our law should be resisted to the utmost.

Very truly yours

Charles Kingsley

BRIQUETTING MACHINE FOR METAL SCRAP

THE development of a briquetting machine for cast-iron borings and steel chips has increased the value of that scrap metal almost threefold. This is vouched for by its users, including the Timken Roller Bearing Company, The National Tube Company, and a number of large automobile manufactories and other plants that have hundreds of tons of this material to dispose of annually.

Experience has shown that chips and turnings of this sort, when held together loosely, cannot be profitably remelted. But in the form of well-compacted briquettes, such as the machine is capable of producing, the scrap constitutes what might be called selected stock that can be melted with as little loss as is pig iron.

The Buick Motor Company has installed in its Flint, Mich., plant a Southwark briquetting machine having a rated output of 3 tons per hour. This is the largest made—ranging from that size on down to a machine of ½ ton capacity. One briquette is made at every cycle of the plunger—the forward stroke forcing the chips from the magazine into the compression chamber under a pressure of 300 tons, and the return stroke stripping the finished product from the chamber—the magazine the while being recharged with chips. Briquettes with a density of as high as 85 per cent can be turned out; and, although no binder is used, they hold together even when dropped on a hard surface. When used for briquetting steel turnings, the machine is provided with a special hopper that breaks up the pieces so that they can be fed easily into the compression chamber. At the plant in question the scrap value of the metal was formerly $7 a ton. Now it is said to be $20 a ton.

A network of gas mains 73 miles long is proposed for the South Yorkshire coke-oven district in England in order to put to more general use the great volume of gas which is a by-product of that industry. The gas is suitable for domestic lighting and heating and for industrial consumption; but so far much of the 80,000,000 cubic feet of gas produced every 24 hours when the nineteen coke-oven plants in the region are working to capacity, has gone to waste.